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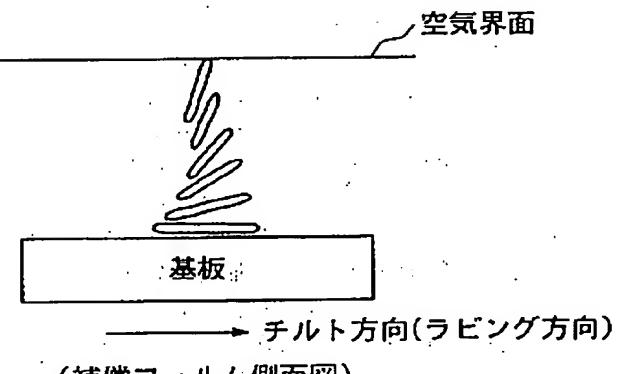
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(54)【発明の名称】 液晶表示装置

(57)【要約】

【課題】 表示コントラスト、階調特性および表示色の視角特性の改良されたツイステッドネマチック型の液晶表示装置を提供する。

【解決手段】 光学的に正の一軸性を示す液晶性高分子から形成され、当該液晶性高分子が液晶状態において形成したネマチックハイブリッド配向を固定化した少なくとも1枚の補償フィルム、電極を備えた一対の透明基板と当該基板間に挟持されたネマチック液晶とから構成される駆動用ツイステッドネマチック型液晶セルおよび当該液晶セルの上下に配置される2枚の偏光板とから構成され、且つ前記液晶セルを構成するネマチック液晶の屈折率異方性(Δn)と当該液晶セルにおける液晶層の厚み(d)との積($\Delta n d$)が200nm~500nm以下であるツイステッドネマチック型液晶表示装置。



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【特許請求の範囲】

【請求項1】光学的に正の一軸性を示す液晶性高分子から実質的に形成され、当該液晶性高分子が液晶状態において形成したネマチックハイブリッド配向を固定化した少なくとも1枚の補償フィルム、電極を備えた一対の透明基板と当該基板間に挟持されたネマチック液晶セルおよび当該液晶セルの上下に配置される2枚の偏光板とから少なくとも構成され、且つ前記液晶セルを構成するネマチック液晶の屈折率異方性(Δn)と当該液晶セルにおける液晶層の厚み(d)との積($\Delta n d$)が200nm~500nm以下であることを特徴とするツイステッドネマチック型液晶表示装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、表示コントラスト、階調特性および表示色の視野角特性の改良されたツイステッドネマチック型液晶表示装置に関する。

【0002】

【従来の技術】TFT素子あるいはMIM素子などを用いたアクティオド駆動のツイステッドネマチック型液晶表示装置(以下TN-LCDと略称する)は、薄型、軽量、低消費電力というLCDの本来の特長に加えて、正面から見た場合CRTに匹敵する画質を有するために、ノートパソコン、携帯用テレビ、携帯用情報端末などの表示装置として広く普及している。しかしながら、従来のTN-LCDにおいては、液晶分子の持つ屈折率異方性のため斜めから見たときに表示色が変化するあるいは表示コントラストが低下するという視野角の問題が本質的に避けられず、その改良が強く望まれており、改良のための様々な試みがなされている。

【0003】一つの画素を分割してそれぞれの画素への印可電圧を一定の比で変える方法(ハーフトーングレースケール法)、一つの画素を分割してそれぞれの画素での液晶分子の立ち上がり方向を変える方法(ドメイン分割法)、液晶に横電界をかける方法(IPS法)、垂直配向させた液晶を駆動する方法(V-A液晶法)、あるいはペンド配向セルと光学補償板を組み合わせる方法(O-CB法)などが提案され、開発・試作されている。

【0004】しかしながらこれらの方法は一定の効果はあるものの、配向膜、電極、液晶配向などを変えなければならず、そのための製造技術確立および製造設備の新設が必要となり、結果として製造の困難さとコスト高を招いている。

【0005】一方TN-LCDの構造は一切変えず、従来のTN-LCDに光学補償フィルムを組み込むことで視野角を拡大させる方法がある。この方法はTN-LCD製造設備の改良・増設が不要でコスト的に優れおり、簡便に使用できる利点があるため注目されており多くの提案がある。

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【0006】ノーマリーホワイト(NW)モードのTN-LCDに視野角問題が発生する原因是、電圧を印可した黒表示時のセル中の液晶の配向状態にある。この場合液晶はほぼ垂直配向しており光学的に正の一軸性となっている。したがって視野角を広げるための光学補償フィルムとしては、液晶セルの黒表示時の正の一軸性を補償するために、光学的に負の一軸性を示すフィルムを用いる提案がなされている。またセル中の液晶が、黒表示時においても、配向膜界面付近ではセル界面と平行もしくは傾いた配向をしていることに着目し、光学軸が傾いた負の一軸性のフィルムを用いて補償することによって、さらに視野角拡大効果を高める方法も提案されている。

【0007】例えば特開平4-349424、6-250166号公報にはらせん軸が傾いたコレステリックフィルムを用いた光学補償フィルムおよびそれを用いたLCDが提案されている。しかしながららせん軸が傾いたコレステリックフィルムを製造することは困難であり、実際にこれら特許中にはらせん軸を傾けるための方法がまったく記載されていない。また特開平5-2495

20 47、6-331979号公報には光軸が傾いた負の一軸補償器を用いたLCDが提案されており、具体的な実施態様としては多層薄膜補償器を用いている。さらに特開平7-146409、8-5837号公報などにおいて光軸が傾いた負の一軸性補償フィルムとしてディスコチック液晶を傾斜配向させた光学補償フィルム及びそれを用いたLCDが提案されている。しかしながらディスコチック液晶は化学構造が複雑であり合成が煩雑である。また低分子液晶であるためにフィルム化する場合、光架橋などの複雑なプロセスを必要とし、工業的製造に困難が伴い結果的にコスト高となる。

【0008】補償フィルムの他の形態としては正の一軸性を有する液晶性高分子を用いた配向フィルムも提案されている。例えば特開平7-140326号公報においてねじれチルト配向した液晶性高分子フィルムからなるLCD用補償板が提案されており、LCDの視野角拡大に用いられている。しかししながらチルト配向に加えてねじれ配向を同時に導入することは工業的には容易ではない。また特開平7-198942、7-181324号公報には類似技術として、ネマチック液晶性高分子を光軸が板面と交差するように配向させたフィルムからなる視角補償板及びそれを用いたLCDが提案されている。

しかししながらこの場合も光軸を単純に傾斜させた補償板を用いているため、視野角拡大効果が十分とは言えない。

【0009】
【発明が解決しようとする課題】本発明はこれら上記課題を解決するものであり、特定の駆動用ツイステッドネマチック型液晶セルとネマチックハイブリッド配向補償フィルムとを組み合わせることにより、従来にない高コントラスト、広視野角化が達成されたツイステッドネマ

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チック型液晶表示装置を提供するものである。

【0010】

【課題を解決するための手段】すなわち本発明は、光学的に正の一軸性を示す液晶性高分子から実質的に形成され、当該液晶性高分子が液晶状態において形成したネマチックハイブリッド配向を固定化した少なくとも1枚の補償フィルム、電極を備えた一对の透明基板と当該基板間に挟持されたネマチック液晶とから構成される駆動用ツイステッドネマチック型液晶セルおよび当該液晶セルの上下に配置される2枚の偏光板とから少なくとも構成され、且つ前記液晶セルを構成するネマチック液晶の屈折率異方性(Δn_c)と当該液晶セルにおける液晶層の厚み(d)との積($\Delta n_c d$)が200nm～500nm以下であることを特徴とするツイステッドネマチック型液晶表示装置である。

【0011】

【発明の実施の形態】以下、本発明についてさらに詳しく説明する。本発明に用いられる駆動用ツイステッドネマチック型液晶セル(以下、TN液晶セルと略す)を駆動方式で分類すると、単純マトリクス方式、能動素子を電極として用いるTFT(Thin Film Transistor)電極、MIM(Metal Insulator Metal)、およびTFD(Thin Film Diode)電極を用いるアクティブマトリクス方式等のように細分化できる。本発明では、いずれの駆動方式のTN液晶セルに対して顕著な効果を発揮することができる。

【0012】本発明に用いられるTN液晶セルは、当該液晶セルの屈折率異方性(Δn_c)と当該液晶セルの液晶層の厚み(d)との積で示される $\Delta n_c d$ 値が、通常200nm～500nm以下、好ましくは250nm～470nm以下、特に好ましくは300nm～450nm以下、最も好ましくは300nm～400nmの範囲である。 500 nm より大きい場合、後ほど説明する補償フィルムと組み合わせた際の視野角改善効果が乏しくなる恐れがあり、また応答速度が遅くなる可能性がある。また200nmより小さい場合、当該補償フィルムと組み合わせた際、視野角の改善効果はあるものの正面の輝度、コントラストの低下を生じる恐れがある。

【0013】またTN液晶セルは、ネマチック液晶の液晶分子の配向欠陥を低減するためにあらかじめ当該液晶分子にプレチルト角を与えることが好ましい。プレチルト角は通常5°以下である。

【0014】また、一般にTN液晶セルは、当該液晶セル内のネマチック液晶の長軸が上下基板間でおよそ90°ねじれている。液晶セルに電圧を印可しない状態では入射した直線偏光はその旋光性により90°ねじれて出射する。液晶セルに電圧を印可すると液晶分子の長軸は電界方向に配向し旋光性は消失する。よってこの旋光の効果を十分に得るために、本発明に用いられるTN液晶

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セルのツイスト角は、通常70°～110°、好ましくは85°～95°であることが望ましい。なお当該液晶セル中の液晶分子のねじれ方向は、左および右方向のどちらでも良い。

【0015】次いで本発明に用いられる補償フィルムについて説明する。当該フィルムは、光学的に正の一軸性を示す液晶性高分子、具体的には①光学的に正の一軸性を示す液晶性高分子化合物、または②少なくとも1種の該液晶性高分子化合物を含有する光学的に正の一軸性を示す液晶性高分子組成物、から成り、該液晶性高分子化合物または該液晶性高分子組成物が液晶状態において形成したネマチックハイブリッド配向を固定化して形成される。

【0016】当該補償フィルムは、ネマチックハイブリッド配向を固定化したフィルムであるがため、液晶性高分子のダイレクターがフィルムの膜厚方向のすべての場所において異なる角度を向いている。したがって当該補償フィルムは、フィルムという構造体として見た場合、もはや光軸は存在しない。

【0017】このようなネマチックハイブリッド配向を固定化した補償フィルムは、該フィルムの上面と下面とでは光学的に等価ではない。したがって上記において説明したTN液晶セルに配置する場合、どちらの面を該液晶セル側に配置するかによって視野角拡大効果が多少異なる。本発明では、どちらの面を配置しても十分な視野角拡大効果を得ることができるが、ながらも補償フィルムの上下2面の内、液晶性高分子のダイレクターとフィルム平面との成す角度が小さな方の面を液晶セルに最も近接するように配置することが望ましい。ここで本発明に用いられる補償フィルムの種々のパラメーターについて説明する。

【0018】先ず補償フィルムの膜厚は、通常0.1～20μm、好ましくは0.2～10μm、特に好ましくは0.3～5μmの範囲である。膜厚が0.1μm未満の時は、十分な補償効果が得られない恐れがある。また膜厚が20μmを越えるとディスプレーの表示が不必要に色づく恐れがある。

【0019】次いで補償フィルムの法線方向から見た場合の面内の見かけのリターデーション値について説明する。ネマチックハイブリッド配向したフィルムでは、ダイレクターに平行な方向の屈折率(以下n_eと呼ぶ)と垂直な方向の屈折率(以下n_oと呼ぶ)が異なっている。n_eからn_oを引いた値を見かけ上の複屈折率とした場合、見かけ上のリターデーション値は見かけ上の複屈折率と絶対膜厚との積で与えられる。この見かけ上のリターデーション値は、エリプソメトリー等の偏光光学測定により容易に求めることができる。該補償フィルムの見かけ上のリターデーション値は、550nmの単色光に対して、通常5～500nm、好ましくは10～300nm、特に好ましくは15～150nmの範囲であ

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る。見かけのリターデーション値が5 nm未満の時は、十分な視野角拡大効果が得られない恐れがある。また、500 nmより大きい場合は、斜めから見たときにディスプレーに不必要的色付きが生じる恐れがある。

【0020】次いで補償フィルムの上下界面におけるダイレクターの角度について説明する。該ダイレクターの角度は、フィルムの上面または下面界面近傍の一方においては、絶対値として通常60度以上90度以下、好ましくは80度以上90度以下の角度をなし、当該面の反対面においては、絶対値として通常0度以上50度以下、好ましくは0度以上30度以下である。

【0021】次いで補償フィルムの平均チルト角について説明する。本発明においては、膜厚方向における液晶性高分子のダイレクターと基板平面との成す角度の平均値を平均チルト角と定義する。平均チルト角は、クリスタルローテーション法を応用して求めることができる。本発明に用いる補償フィルムの平均チルト角は、通常10～60度、好ましくは20～50度の範囲である。平均チルト角が上記の範囲から外れた場合には、十分な視野角拡大効果が得られない恐れがある。

【0022】本発明に用いられる補償フィルムは、上述の液晶性高分子が実質的に形成され、該液晶性高分子のネマチックハイブリッド配向を有し、かつ上記のパラメーターを有するものであれば特に限定されない。

【0023】本発明の液晶表示装置に用いられる補償フィルムについてさらに詳しく説明する。該補償フィルムを形成する液晶性高分子とは、具体的にはホメオトロピック配向性液晶性高分子、より具体的にはホメオトロピック配向性液晶性高分子化合物または少なくとも1種のホメオトロピック配向性の液晶性高分子化合物を含有する液晶性高分子組成物である。

【0024】ここでホメオトロピック配向とは、液晶のダイレクターが基板平面に対して略垂直に配向した状態をいう。このホメオトロピック配向性液晶性高分子が、本発明に用いる補償フィルムが形成しているネマチックハイブリッド配向を実現するための必須成分である。

【0025】液晶性高分子がホメオトロピック配向性であるか否かの判定は、基板上に液晶性高分子層を形成し、その配向状態を判定することで行う。この判定に用いることのできる基板としては特に限定はないが、例えばガラス基板、より具体的には、ソーダガラス、カリガラス、ホウ珪酸ガラス、クラウンガラス、フリントガラスといった光学ガラスなどや、液晶性高分子の液晶温度において耐熱性のあるプラスチックフィルムまたはシート、より具体的にはポリエチレンテレフタレート、ポリエチレンナフタレート、ポリフェニレンオキサイド、ポリイミド、ポリアミドイミド、ポリエーテルイミド、ポリアミド、ポリエーテルケトン、ポリエーテルエーテルケトン、ポリケトンサルファイド、ポリエーテルスルファンなどを基板として用いることができる。なお、上記

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に例示した基板は、酸、アルコール類、洗剤などで表面を清浄にした後に用いるが、シリコン処理などの表面処理は行わずに用いる。

【0026】本発明に用いるホメオトロピック配向性液晶性高分子とは、上記に例示した基板上に液晶性高分子の膜を形成し、該液晶性高分子が液晶状態を示す温度において、該基板の内どれか1種の基板にてホメオトロピック配向を形成するものをホメオトロピック配向性液晶性高分子と定義する。ただし、液晶性高分子の種類や組成などによつては、液晶一等方相転移点付近の温度で特異的にホメオトロピック配向するものがある。したがつて、通常、液晶一等方相転移点より15℃以下、好ましくは20℃以下の温度で行うことが望ましい。

【0027】該ホメオトロピック配向性液晶性高分子としては、例えば、

① 液晶性高分子の主鎖を構成する構造単位中に嵩高い置換基を有する芳香族基、長鎖アルキル基を有する芳香族基、フッ素原子を有する芳香族基等を有する液晶性高分子、

② 液晶性高分子鎖の末端または両末端に、炭素数3～20の長鎖アルキル基または炭素数2～20の長鎖フルオロアルキル基などを有し、モノアルコールやモノカルボン酸などの官能性部位を一つ有する化合物から誘導される一官能性の構造単位を有する液晶性高分子、などが挙げられる。

【0028】上記②の液晶性高分子に用いられる一官能性の構造単位とは、液晶性高分子である縮合重合体を形成する際に用いる二官能性单量体がもつ官能基に相当する官能基を1個持つ单量体を該重合体の製造時(重合反応中または重合反応後)に共存させて該重合体分子中に組み込まれた構造のことをいい、通常該重合体分子の片末端または両末端に組み込まれる。従つて該重合体分子中に存在する該一官能性の構造単位の数は通常1分子あたり1～2個である。該一官能性の構造単位を一般式で表すと次のようになる。

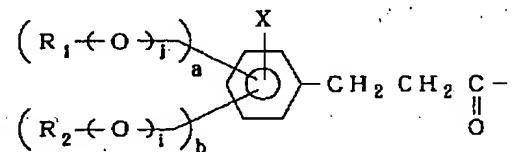
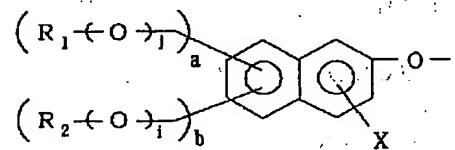
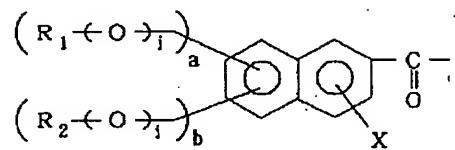
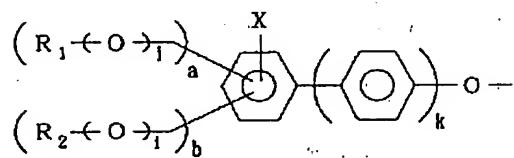
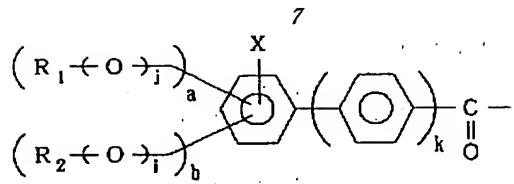
【0029】

【化1】

40

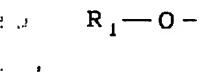
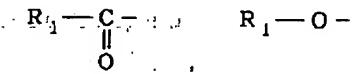
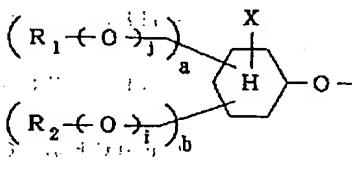
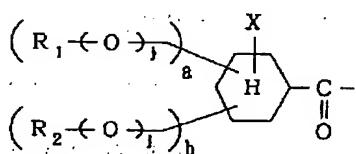
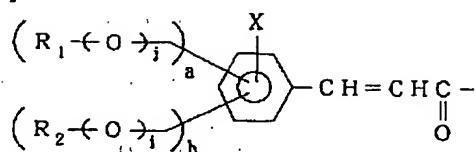
50

(5)



【0030】

【化2】

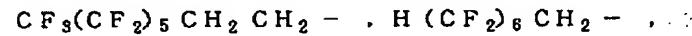
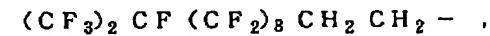
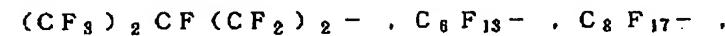
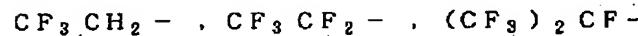
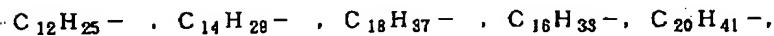
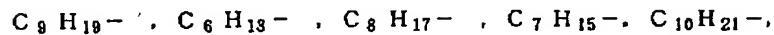
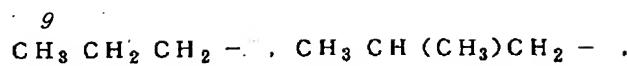


【0031】上記一般式において、 R_1 および R_2 は同一または異なっていても良い。 R_1 および R_2 は、炭素数3~20の長鎖アルキル基または炭素数2~20の長鎖フルオロアルキル基を表す。具体的には、

【0032】

【化3】

(6)



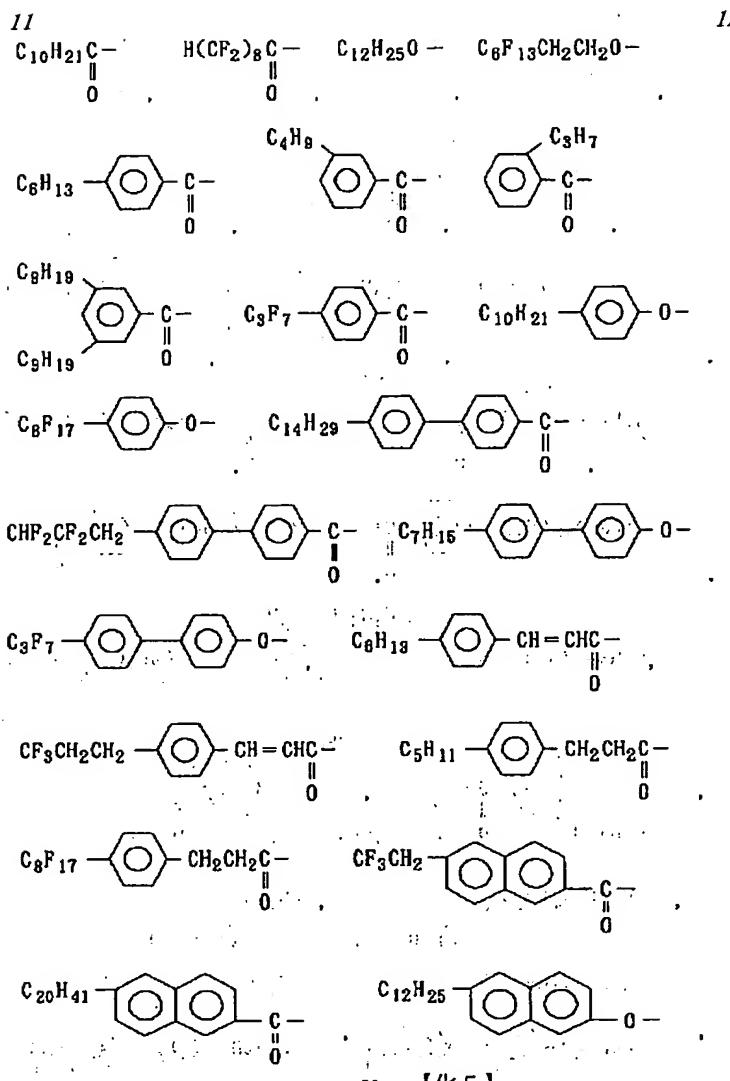
【0033】などを好ましいものとして例示することができる。またXは、水素、フッ素、塩素などのハロゲンなどである。またiは、0または1である。またjは、0または1である。またkは、0または1である。さらにaは0または1、bは0または1である。但し、a +

b ≠ 0である。上記のモノアルコール、モノカルボン酸およびこれらの機能性誘導体より形成される一官能性の構造単位として、

【0034】

30 【化4】

(7)

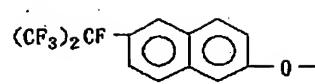


[0035]

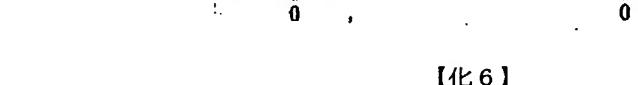
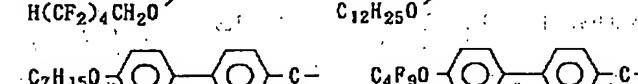
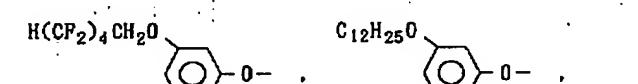
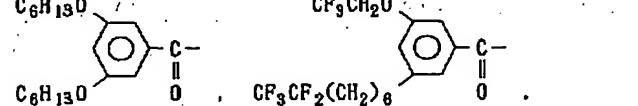
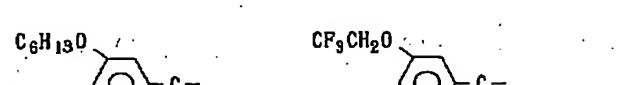
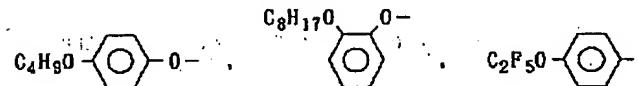
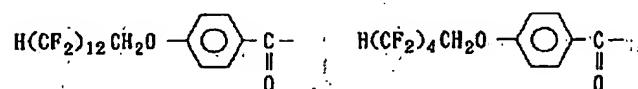
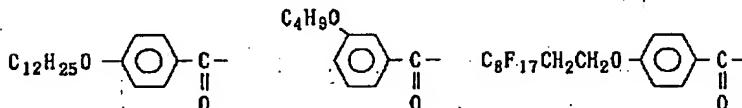
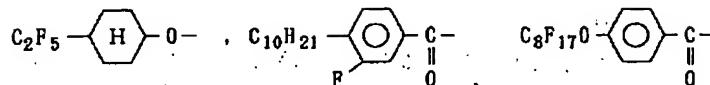
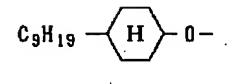
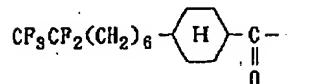
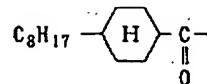
30 【化5】

(8)

13



14

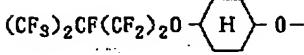
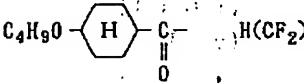
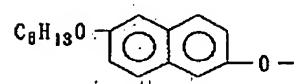
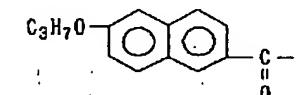
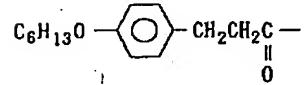
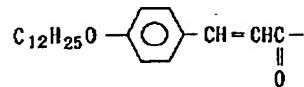
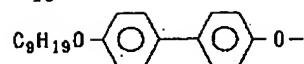


【0036】

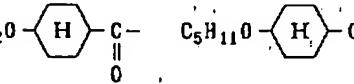
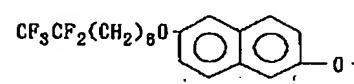
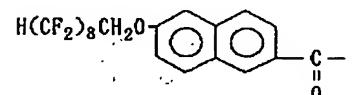
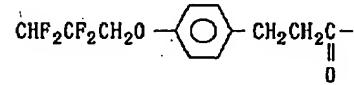
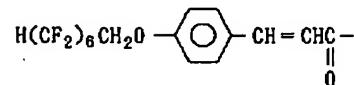
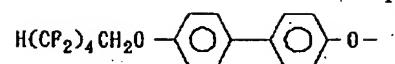
【化6】

(9)

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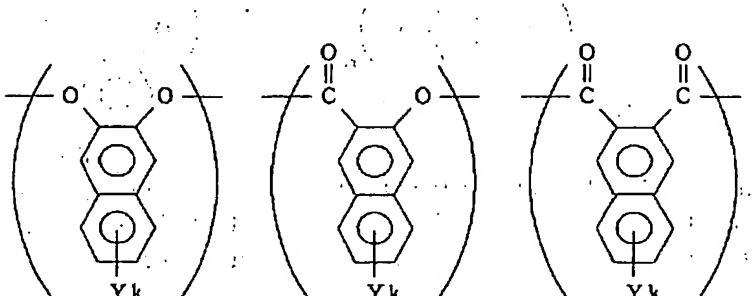
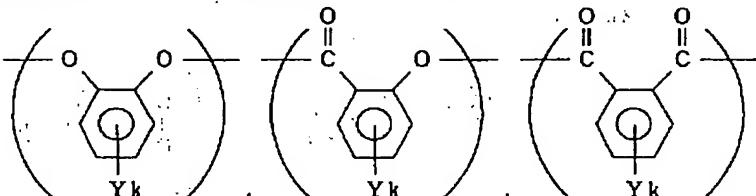
【0037】などを好ましい単位として例示することができる。上記に例示した一官能性の構造単位から選ばれる1種若しくは2種によって高分子鎖の片末端または両末端を構成する。なお両末端に該構造単位を有する際には、両末端の単位が同一である必要はない。

【0038】具体的な液晶性高分子としては、①および／または②の条件を満たす例えればポリエステル、ポリイミド、ポリアミド、ポリカーボネート、ポリエスチレインミド等の主鎖型液晶性高分子が挙げられる。これらの中でも特に合成の容易さ、フィルム化の容易さおよび得られたフィルムの物性の安定性などから液晶性ポリエステルが好ましい。一般的に液晶性ポリエステルの主鎖は、*

* ジカルボン酸単位、ジオール単位およびオキシカルボン酸単位などの二官能性構造単位や該単位以外の多官能性の構造単位から形成される。本発明に用いられる補償フィルムを形成する液晶性ポリエステルとしては、主鎖中にオルソ置換芳香族単位を有するものがより好ましい。具体的には次に示すようなカテコール単位、サリチル酸単位、フタル酸単位、2, 3-ナフタレンジオール単位、2, 3-ナフタレンジカルボン酸単位およびこれら30のベンゼン環に置換基を有するものなどを挙げができる。

【0039】

【化7】



【0040】(YはCl, Brなどのハロゲン、メチル基、エチル基、メトキシ基、エトキシ基またはフェニル

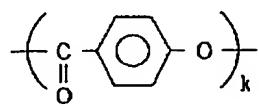
(10)

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基を示す。またkは0~2である。)

以下に上記①および②の条件を満たすホメオトロピック
配向性の液晶性ポリエステルの具体的な構造例を示す。*

構造式1

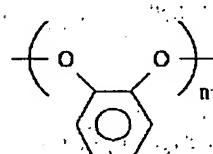
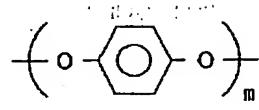
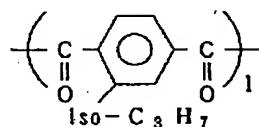


*①の条件を満たすものとしては、

【0041】

【化8】

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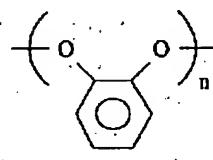
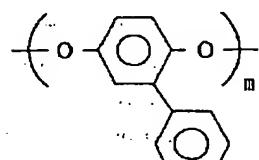
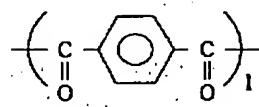
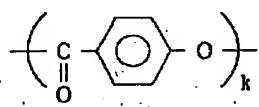
【0042】 $l=m+n$ 、 $k/l=20/10 \sim 0/1$ 0、好ましくは $15/10 \sim 0/10$ $n/m=100/0 \sim 20/80$ 、好ましくは $98/2$
 $\sim 30/70$

※ k, l, m, n はそれぞれモル組成比を示す。

【0043】

【化9】

構造式2

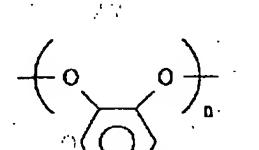
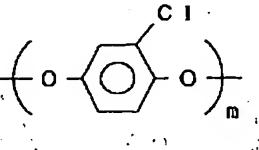
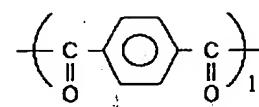
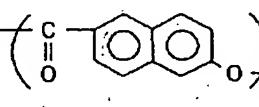
【0044】 $l=m+n$ 、 $k/l=20/10 \sim 0/1$ 0、好ましくは $15/10 \sim 0/10$ $m/n=100/0 \sim 1/99$ 、好ましくは $90/10$
 $\sim 2/98$

★ k, l, m, n はそれぞれモル組成比を示す。

【0045】

【化10】

構造式3

【0046】 $l=m+n$ 、 $k/l=20/10 \sim 0/1$ 0、好ましくは $15/10 \sim 0/10$ $n/m=100/0 \sim 1/99$ 、好ましくは $90/10$
 $\sim 2/98$

k, l, m, n はそれぞれモル組成比を示す。

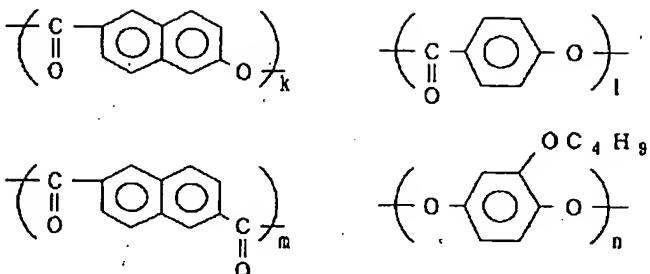
【0047】

【化11】

(11)

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構造式4

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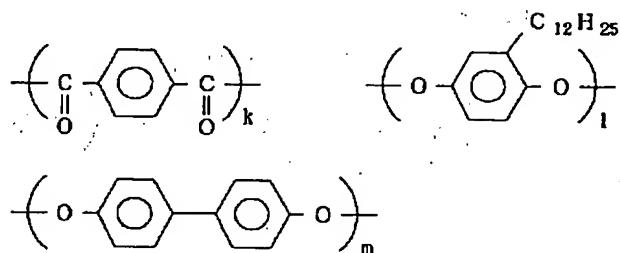
【0048】 $m=n$ 、 $(k+1)/m=20/10 \sim 2/10$ 、好ましくは $15/10 \sim 5/10$
 $k/l=100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$

* k , l , m , n はそれぞれモル組成比を示す。

【0049】

【化12】

構造式5

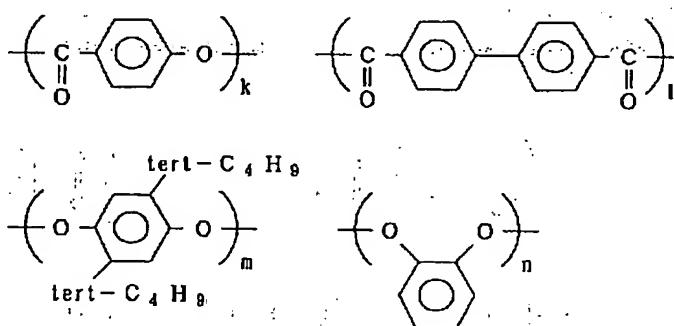


【0050】 $k=m+n$ 、 $l/m=100/0 \sim 1/9$
 9、好ましくは $90/10 \sim 2/98$
 k , l , m はそれぞれモル組成比を示す。

※ 【0051】

【化13】

構造式6



【0052】 $l=m+n$ 、 $k/l=20/10 \sim 0/1$
 0、好ましくは $15/10 \sim 0/10$
 $m/n=100/0 \sim 1/99$ 、好ましくは $90/10 \sim 2/98$

k , l , m , n はそれぞれモル組成比を示す。

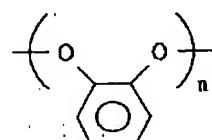
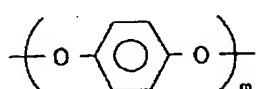
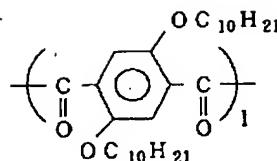
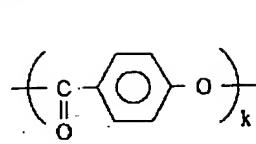
【0053】

【化14】

(12)

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構造式7

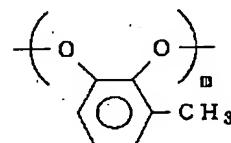
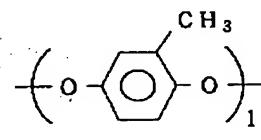
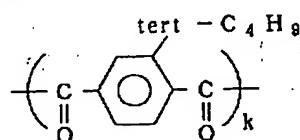
【0054】 $l = m + n$ 、 $k/l = 20/10 \sim 0/1$ 0、好ましくは $15/10 \sim 0/10$ $m/n = 100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$ * k 、 l 、 m 、 n はそれぞれモル組成比を示す。

【0055】

【化15】

*

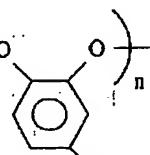
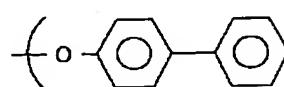
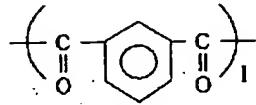
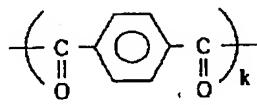
構造式8

【0056】 $k = l + m$ 、 $l/m = 100/0 \sim 0/1$ ※ 【0057】00、好ましくは $95/5 \sim 5/95$

【化16】

 k 、 l 、 m 、 n はそれぞれモル組成比を示す。※

構造式9

iso- C_3H_7 【0058】 $k+l = m+n$ 、 $k/l = 100/0 \sim 0$ k 、 l 、 m 、 n はそれぞれモル組成比を示す。 $/100$ 、好ましくは $95/5 \sim 5/95$

【0059】

 $n/m = 100/0 \sim 1/99$ 、好ましくは $90/10$

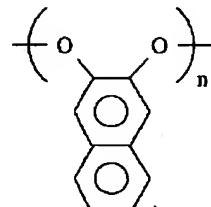
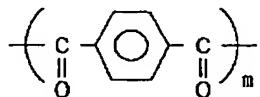
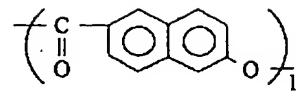
【化17】

 $\sim 2/98$

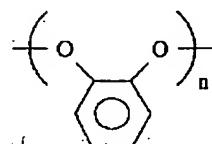
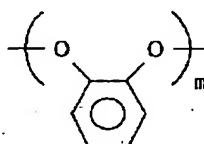
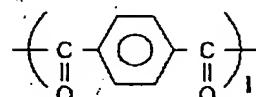
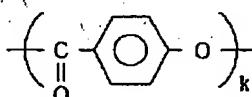
(13)

23
構造式 1 0

24

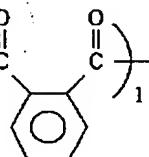
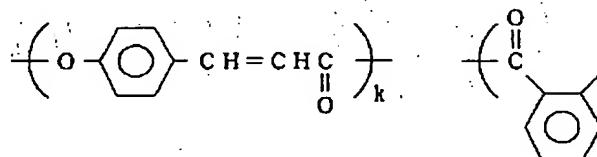
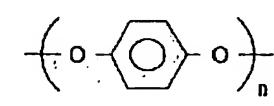
【0060】 $m=n$ 、 $(k+1)/m = 2.0/1.0 \sim 2/1.0$ 、好ましくは $5/1.0 \sim 5/1.0$ k, l, m, n はそれぞれモル組成比を示す。* 【0061】
【化18】

構造式 1 1

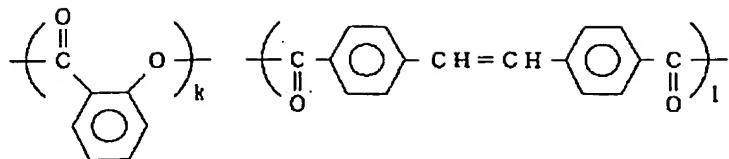
tert-C₄H₉【0062】 $l=m+n$ 、 $k/l = 2.0/1.0 \sim 0/1$ ※ k, l, m, n はそれぞれモル組成比を示す。
0、好ましくは $1.5/1.0 \sim 0/1.0$
 $n/m = 1.00/0 \sim 1/9.9$ 、好ましくは $9.0/1.0 \sim 2/9.8$ 【化19】

※

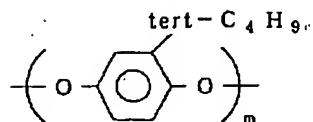
構造式 1 2

iso-C₉H₇【0064】 $n=m+l$ 、 $k/n = 2.0/1.0 \sim 0/1$ ※ k, l, m, n はそれぞれモル組成比を示す。
0、好ましくは $1.5/1.0 \sim 0/1.0$
 $m/l = 1.00/0 \sim 1/9.9$ 、好ましくは $9.0/1.0 \sim 2/9.8$ 【化20】

(14)

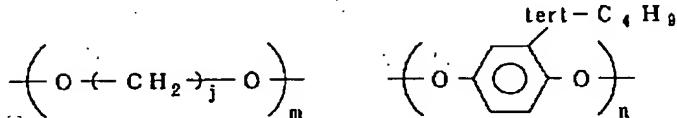
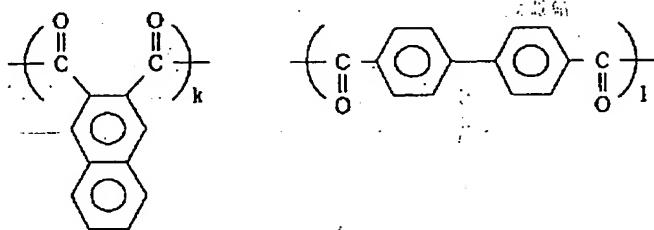
25
構造式 1 3

26

【0066】 $l = m$ 、 $k/l = 20/10 \sim 0/10$ 、 * 【0067】好ましくは $15/10 \sim 0/10$ k , l , m はそれぞれモル組成比を示す。

*

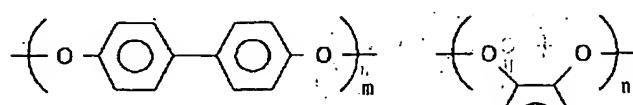
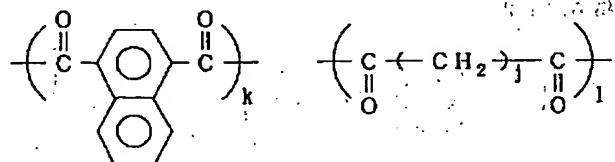
構造式 1 4

【0068】 $k+l=m+n$ 、 $k/l=100/0 \sim 0/100$ 、 好ましくは $95/5 \sim 5/95$
 $m/n=100/0 \sim 0/100$ 、 好ましくは $95/5 \sim 5/95$ ※ k , l , m , n はそれぞれモル組成比を示す。 j は $2 \sim 1 \cdot 2$ の整数を示す。

【0069】

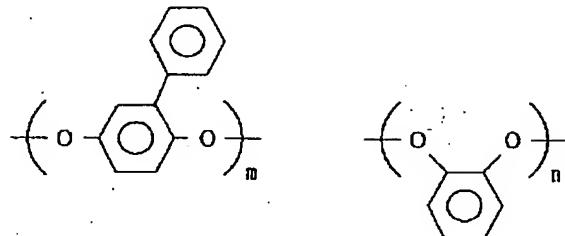
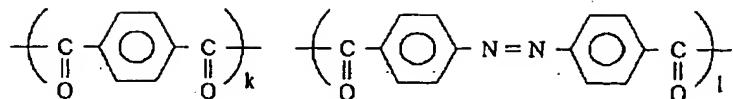
※³⁰ 【化22】

構造式 1 5

iso - C₃H₇【0070】 $k+l=m+n$ 、 $k/l=100/0 \sim 0/100$ 、 好ましくは $95/5 \sim 5/95$
 $m/n=100/0 \sim 0/100$ 、 好ましくは $95/5 \sim 5/95$ k, l, m, n はそれぞれモル組成比を示す。 j は $2 \sim 1 \cdot 2$ の整数を示す。
【0071】

【化23】

(15)

27
構造式 16

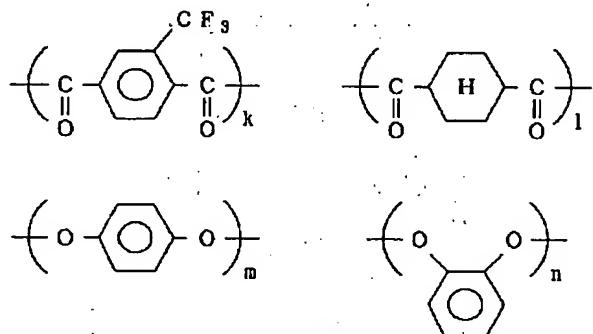
【0072】 $k+l=m+n$ 、 $k/l=100/0 \sim 0$
 $/100$ 、好ましくは $95/5 \sim 5/95$
 $m/n=100/0 \sim 1/99$ 、好ましくは $90/10 \sim 2/98$

* k, l, m, n はそれぞれモル組成比を示す。

【0073】

【化24】

構造式 17



【0074】 $k+l=m+n$ 、 $k/l=100/0 \sim 1$
 $/99$ 、好ましくは $90/10 \sim 2/98$

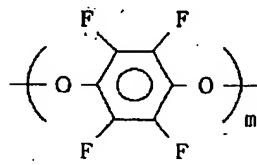
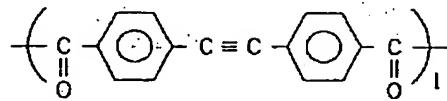
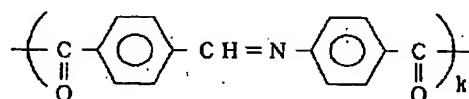
$m/n=100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$

k, l, m, n はそれぞれモル組成比を示す。

【0075】

【化25】

構造式 18



【0076】 $k+l=m+n$ 、 $k/l=100/0 \sim 0$
 $/100$ 、好ましくは $95/5 \sim 5/95$
 $m/n=100/0 \sim 1/99$ 、好ましくは $90/10 \sim 2/98$

k, l, m, n はそれぞれモル組成比を示す。

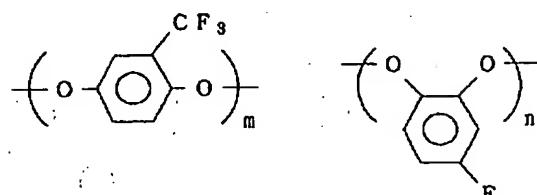
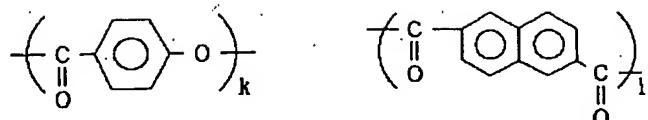
50 【0077】

(16)

29

【化26】

構造式19

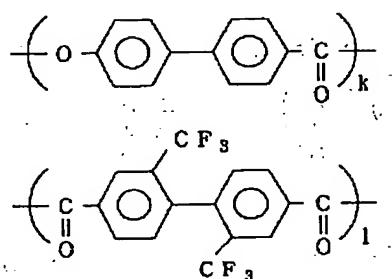


【0078】 $l = m+n$, $k/l = 20/10 \sim 0/1$
0、好ましくは $15/10 \sim 0/10$
 $m/n = 100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$

* k , l , m , n はそれぞれモル組成比を示す。
【0079】

【化27】

構造式20



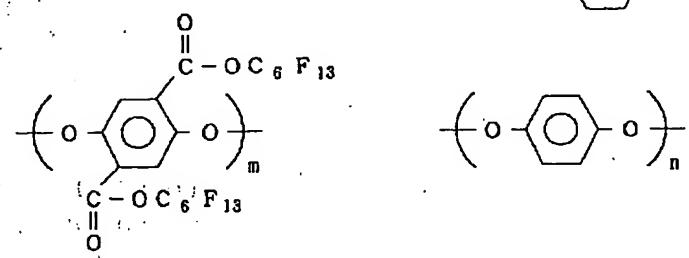
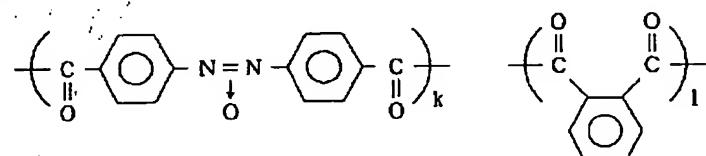
【0080】 $l = m+n$, $k/l = 20/10 \sim 0/1$
0、好ましくは $15/10 \sim 0/10$
 $m/n = 100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$

* k , l , m , n はそれぞれモル組成比を示す。 j は 2 ~ 12 の整数を示す。

【0081】

※ 【化28】

構造式21



【0082】 $k+1 = m+n$, $k/l = 100/0 \sim 0/100$
0、好ましくは $95/5 \sim 5/95$
 $m/n = 100/0 \sim 1/99$ 、好ましくは $90/10 \sim 2/98$

* k , l , m , n はそれぞれモル組成比を示す。などが挙げられる。また②の条件を満たすものとしては、

(17)

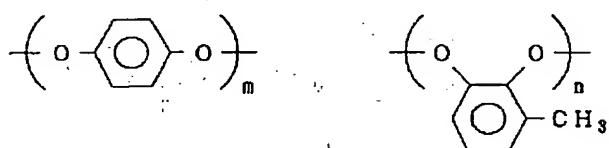
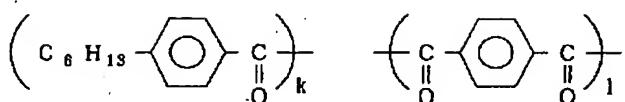
31

【0083】

構造式22

32

* * 【化29】

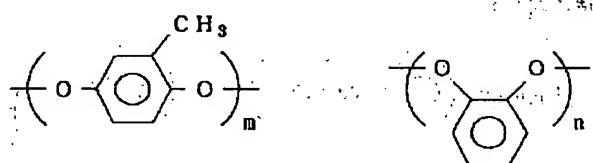
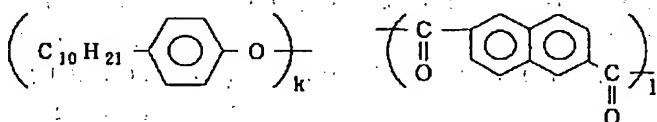
【0084】 $m+n=k/2+1$ $k/l=80/60 \sim 2/99$ 、好ましくは $40/80$ $\sim 10/95$ $m/n=100/0 \sim 0/100$ 、好ましくは $95/5 \star$ ※ $\sim 5/95$

k, l, m, n はそれぞれモル組成比を示す。

【0085】

【化30】

構造式23

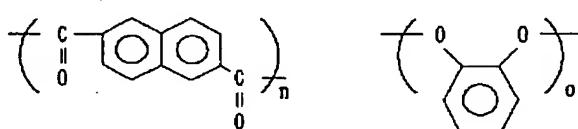
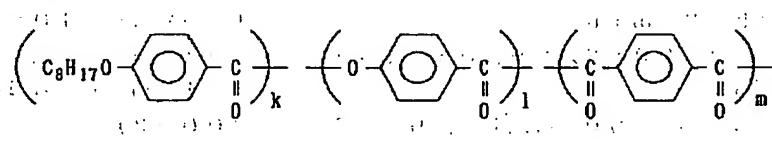
【0086】 $l=k/2+m+n$ $k/(m+n)=80/60 \sim 2/99$ 、好ましくは $40/80 \sim 10/95$ $m/n=100/0 \sim 0/100$ 、好ましくは $95/5 \star$ ★ $\sim 5/95$

k, l, m, n はそれぞれモル組成比を示す。

【0087】

【化31】

構造式24

【0088】 $o=k/2+m+n$ $k/(m+n)=80/60 \sim 2/99$ 、好ましくは $40/80 \sim 10/95$ $m/n=100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$ $l/o=20/10 \sim 0/10$ 、好ましくは $15/10 \sim 5/10$

k, l, m, n, o はそれぞれモル組成比を示す。

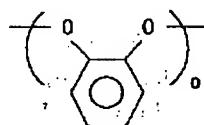
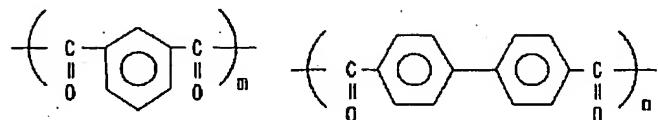
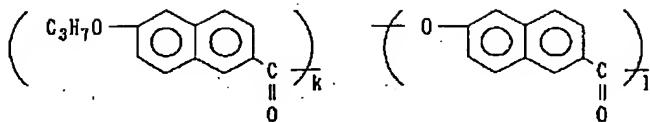
【0089】

【化32】

(18)

33
構造式25

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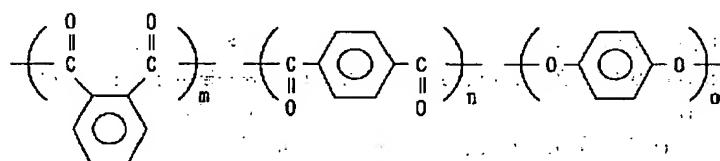
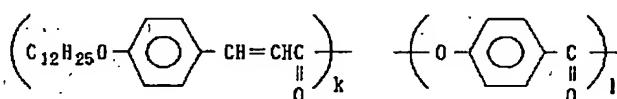
【0090】 $\circ = k/2 + m + n$
 $k/(m+n) = 80/60 \sim 2/99$ 、好ましくは4
 $0/80 \sim 10/95$
 $m/n = 100/0 \sim 0/100$ 、好ましくは95/5
 $\sim 5/95$

* $1/\circ = 20/10 \sim 0/10$ 、好ましくは15/10
 $\sim 5/10$

k, l, m, n, \circ はそれぞれモル組成比を示す。
 【0091】

* 【化33】

構造式26



【0092】 $\circ = k/2 + m + n$
 $k/(m+n) = 80/60 \sim 2/99$ 、好ましくは4
 $0/80 \sim 10/95$
 $m/n = 100/0 \sim 0/100$ 、好ましくは95/5
 $\sim 5/95$

$1/\circ = 20/10 \sim 0/10$ 、好ましくは15/10
 $\sim 5/10$

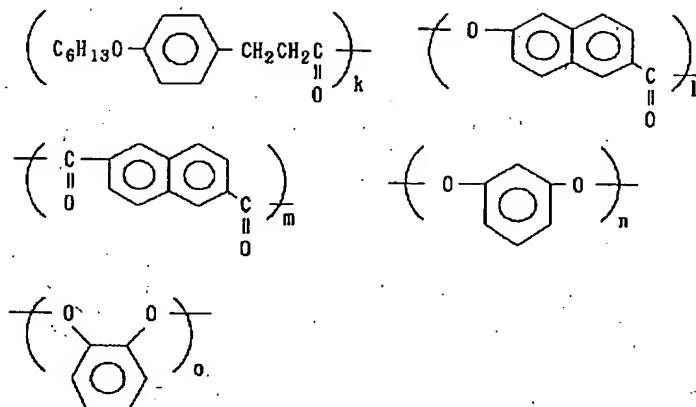
k, l, m, n, \circ はそれぞれモル組成比を示す。
 【0093】

【化34】

(19)

35
構造式 27

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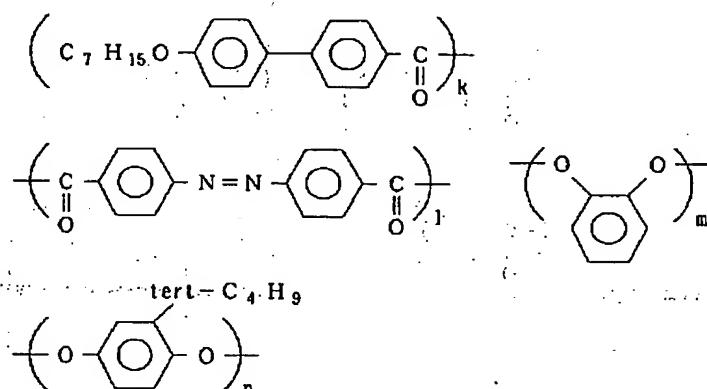


【0094】 $n+o=k/2+m$
 $k/m=80/60 \sim 2/99$ 、好ましくは $40/80 \sim 10/95$
 $n/o=100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$

* $l/(n+o)=20/10 \sim 0/10$ 、好ましくは $15/10 \sim 5/10$
 k, l, m, n, o はそれぞれモル組成比を示す。

【0095】
 【化35】

構造式 28

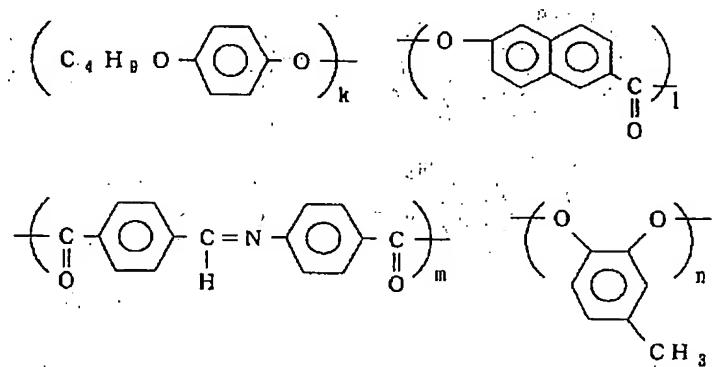


【0096】 $m+n=k/2+l$
 $k/l=80/60 \sim 2/99$ 、好ましくは $40/80 \sim 10/95$
 $m/n=100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$

※～5/95

【0097】
 【化36】

構造式 29

【0098】 $m=k/2+n$

$k/n=80/60 \sim 2/99$ 、好ましくは $40/80 \sim 10/95$
 $l/m=20/10 \sim 0/10$ 、好ましくは $15/10 \sim 5/95$

～10/95

50

(20)

37

 $\sim 5/10$

k, l, m, nはそれぞれモル組成比を示す。

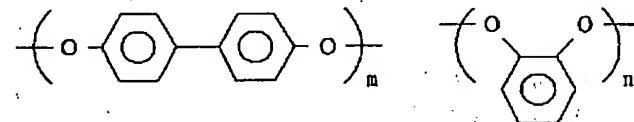
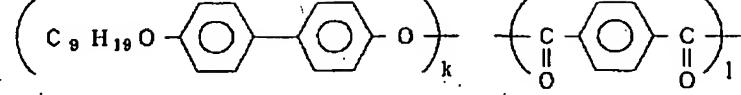
構造式30

38

* [0099]

* [化37]

構造式30



[0100] l = k/2 + m + n

k / (m+n) = 80 / 60 ~ 2 / 99、好ましくは4

0 / 80 ~ 10 / 95

m / n = 100 / 0 ~ 0 / 100、好ましくは95 / 5

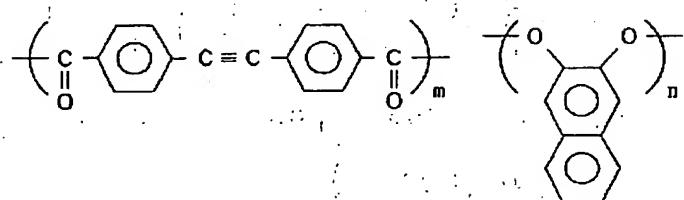
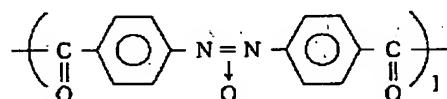
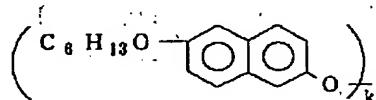
※ ~ 5 / 95

k, l, m, nはそれぞれモル組成比を示す。

[0101]

[化38]

構造式31



[0102] l + m = k / 2 + n

★ ~ 5 / 95

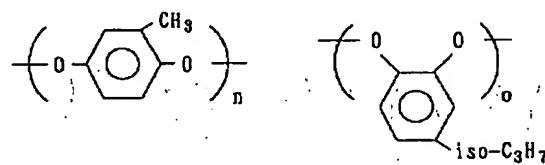
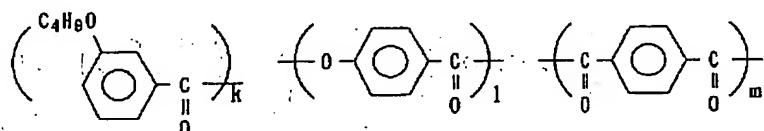
k / n = 80 / 60 ~ 2 / 99、好ましくは40 / 80 k, l, m, nはそれぞれモル組成比を示す。

~ 10 / 95

[0103]

1 / m = 100 / 0 ~ 0 / 100、好ましくは95 / 5 ★ [化39]

構造式32



[0104] n + o = k / 2 + m

n / o = 100 / 0 ~ 0 / 100、好ましくは95 / 5

k / m = 80 / 60 ~ 2 / 99、好ましくは40 / 80

~ 5 / 95

~ 10 / 95

so 1 / (n + o) = 20 / 10 ~ 0 / 10、好ましくは1

(21)

39

 $5/10 \sim 5/10$

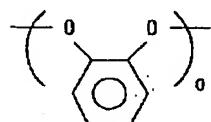
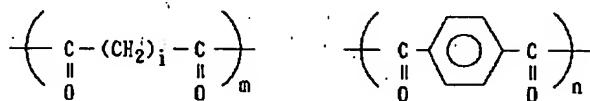
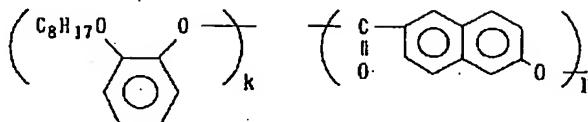
k, l, m, n, oはそれぞれモル組成比を示す。

構造式3-3

40

* 【0105】

* 【化40】

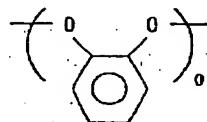
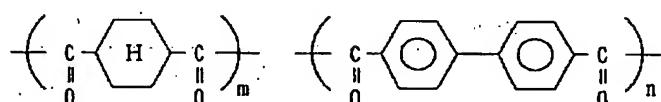
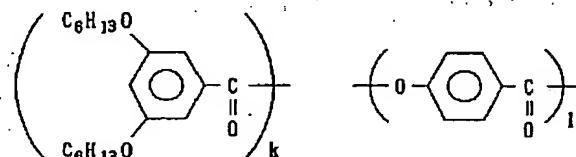
【0106】 $m+n=k/2+o$ $k/o=80/60 \sim 2/99$ 、好ましくは $40/80 \sim 10/95$ $m/n=100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$ $1/(m+n)=20/10 \sim 0/10$ 、好ましくは $1 \times$ ※ $5/10 \sim 5/10$

iは2~12の整数を示す。k, l, m, n, oはそれぞれモル組成比を示す。

【0107】

【化41】

構造式3-4

【0108】 $o=k/2+m+n$ $k/(m+n)=80/60 \sim 2/99$ 、好ましくは $40/80 \sim 10/95$ $m/n=100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$ $1/o=20/10 \sim 0/10$ 、好ましくは $15/10 \sim 5/10$

k, l, m, n, oはそれぞれモル組成比を示す。

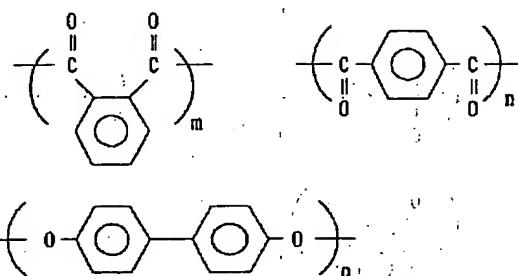
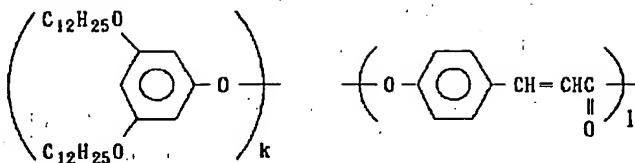
【0109】

【化42】

(22)

41

铸造式 35



$$[0 \ 1 \ 1 \ 0] \ m+n=k/2+o$$

$k/o = 80/60 \sim 2/9.9$ 、好ましくは $40/80$

~1:0/9

$m/n = 100/0 \approx 0/100$, 好ましくは 95/5

≈ 5 / 95

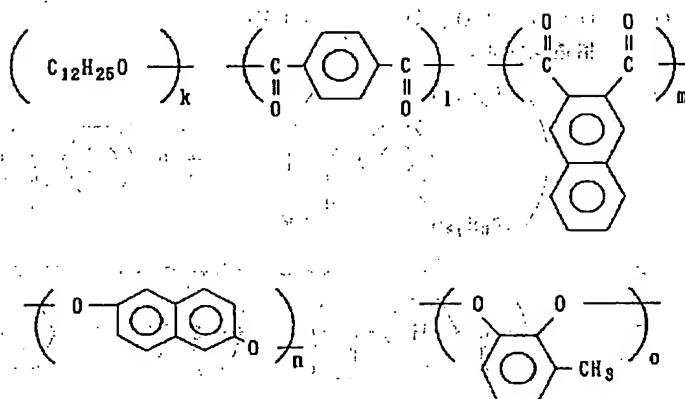
* $1/(m+n) = 20/10 \sim 0/10$ 、好ましくは1

5/10~5/10: $\text{K}^{+}\text{Cl}^{-}$ (1:1)

$k_1, k_2, m_1, m_2, n_1, n_2$ はそれぞれモル組成比を示す。

[0111]

機造式 3.6



$$\{0\ 1\ 1\ 2\} \quad l+m=k/2+n+o$$

$k/(n+o) = 80/60 \sim 2/99$ 、好ましくは4

9/80~10/95

$1/m \equiv 1.00/0 \approx 0/1.00$, 好ましくは $9.5/5$

≈ 5 / 9.5

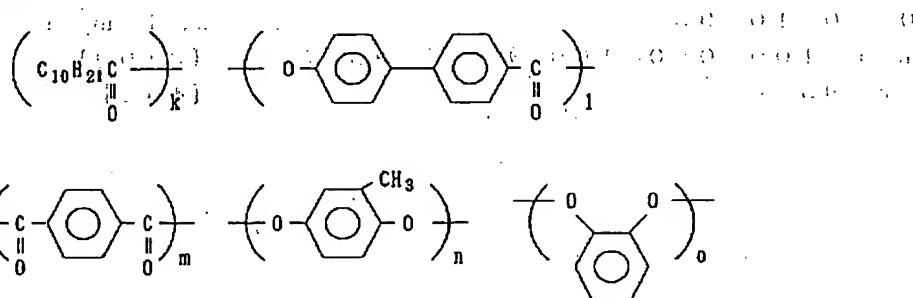
※n/o=100/0~0/100、好ましくは95/5

$\sim 5/9.5$

k , l , m , n , \circ はそれぞれモル組成比を示す。

[9113]

構造式 3.7



$$\{0\ 1\ 1\ 4\} \ n+o=k/2+m$$

$k/m = 80/60 \sim 2/99$ 、好ましくは $40/80$

~10/95

• $n/o = 100/0 \sim 0/100$ 、好みしくは $95/5$

(23)

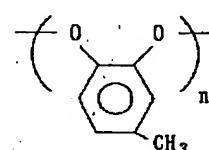
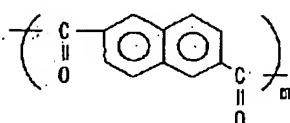
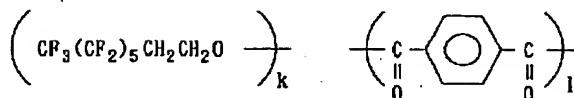
43

 $\sim 5/95$ $l/m = 20/10 \sim 0/10$ 、好ましくは $15/10$ $\sim 5/10$ * k, l, m, n, o はそれぞれモル組成比を示す。

【0115】

* 【化45】

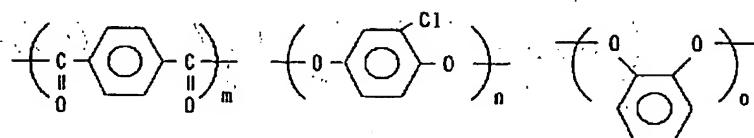
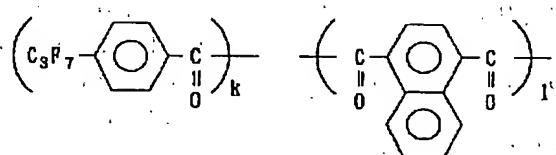
構造式38

【0116】 $l+m=k/2+o$ ※ $\sim 5/95$ $k/o = 80/60 \sim 2/99$ 、好ましくは $40/80$ * k, l, m, n はそれぞれモル組成比を示す。 $\sim 10/95$ $l/m = 100/0 \sim 0/100$ 、好ましくは $95/5$ ※

【0117】

【化46】

構造式39

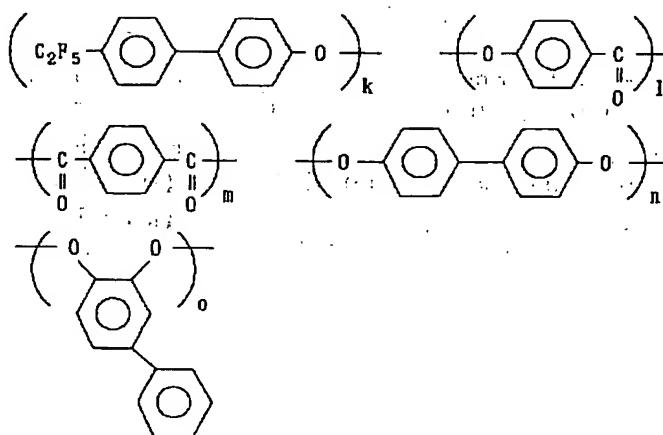
【0118】 $n+o=k/2+l+m$ 30★ $n/o = 100/0 \sim 0/100$ 、好ましくは $95/5$ $k/(l+m) = 80/60 \sim 2/99$ 、好ましくは 4 ~ $5/95$ $0/80 \sim 10/95$ * k, l, m, n, o はそれぞれモル組成比を示す。 $l/m = 100/0 \sim 0/100$ 、好ましくは $95/5$

【0119】

 $\sim 5/95$

★ 【化47】

構造式40

【0120】 $m=k/2+n+o$

0/80 ~ 10/95

 $k/(n+o) = 80/60 \sim 2/99$ 、好ましくは 4 50 $n/o = 100/0 \sim 0/100$ 、好ましくは $95/5$

(24)

45

 $\sim 5/95$ $1/m = 20/10 \sim 0/10$ 、好ましくは $15/10$ $\sim 5/10$

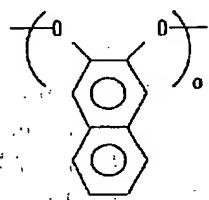
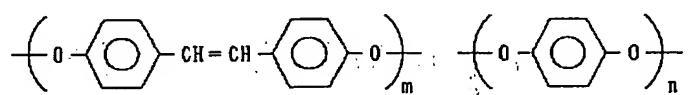
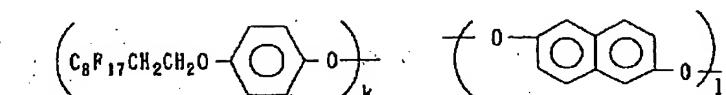
46

* k, l, m, n, o はそれぞれモル組成比を示す。

【0121】

* 【化48】

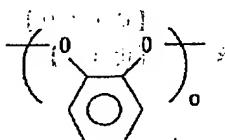
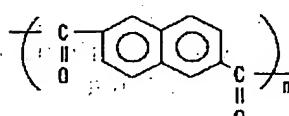
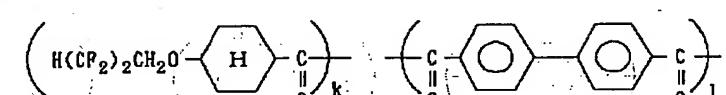
構造式4-1

【0122】 $o = k/2 + m + n$ $k/(m+n) = 80/60 \sim 2/99$ 、好ましくは $4/80 \sim 10/95$ $m/n = 100/0 \sim 0/100$ 、好ましくは $95/5$ $\sim 5/95$ ※ $1/m = 20/10 \sim 0/10$ 、好ましくは $15/10$ 20 ~ $5/10$ * k, l, m, n, o はそれぞれモル組成比を示す。

【0123】

* 【化49】

構造式4-2

【0124】 $n + o = k/2 + l + m$ $k/(l+m) = 80/60 \sim 2/99$ 、好ましくは $4/80 \sim 10/95$ $l/m = 100/0 \sim 0/100$ 、好ましくは $95/5$ $\sim 5/95$ n/o = $100/0 \sim 0/100$ 、好ましくは $95/5$ ~ $5/95$ * k, l, m, n, o はそれぞれモル組成比を示す。

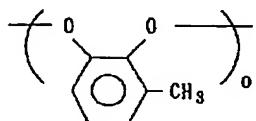
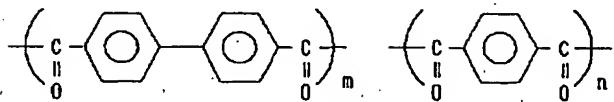
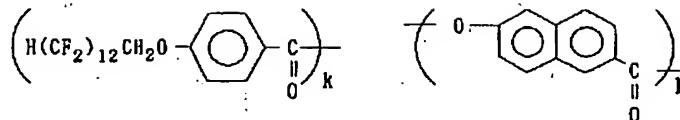
【0125】

* 【化50】

(25)

47
構造式 4.3

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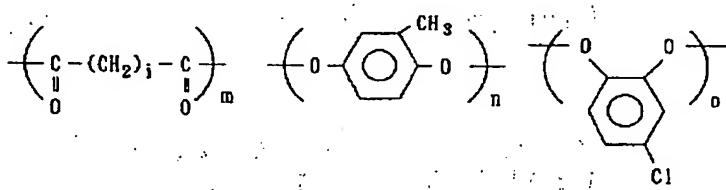
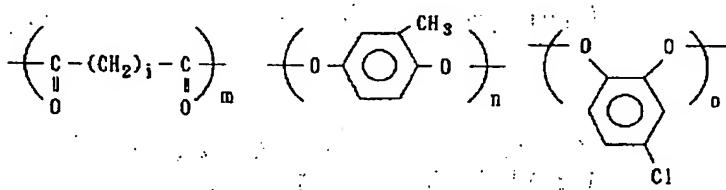
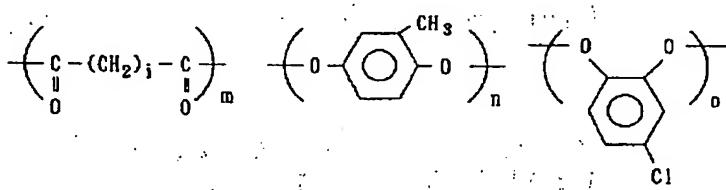
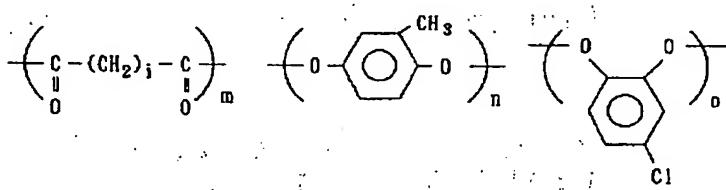
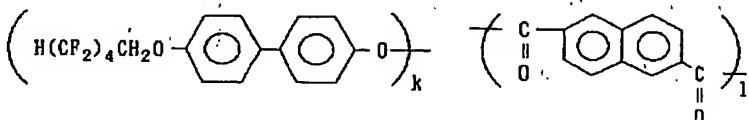
【0126】 $\circ = k/2 + m + n$ $k/(m+n) = 80/60 \sim 2/99$ 、好ましくは4 $0/80 \sim 10/95$ $m/n = 100/0 \sim 0/100$ 、好ましくは95/5 $\sim 5/95$ * $1/\circ = 20/10 \sim 0/10$ 、好ましくは15/10 $\sim 5/10$

k, l, m, n, oはそれぞれモル組成比を示す。

【0127】

【化51】

構造式 4.4

【0128】 $l+m=k/2+n+\circ$ $k/(n+\circ) = 80/60 \sim 2/99$ 、好ましくは4 $0/80 \sim 10/95$ $l/m = 100/0 \sim 0/100$ 、好ましくは95/5 $\sim 5/95$ $n/\circ = 100/0 \sim 0/100$ 、好ましくは95/5 $\sim 5/95$

iは2~12の整数を示す。k, l, m, n, oはそれぞれモル組成比を示す。

【0129】

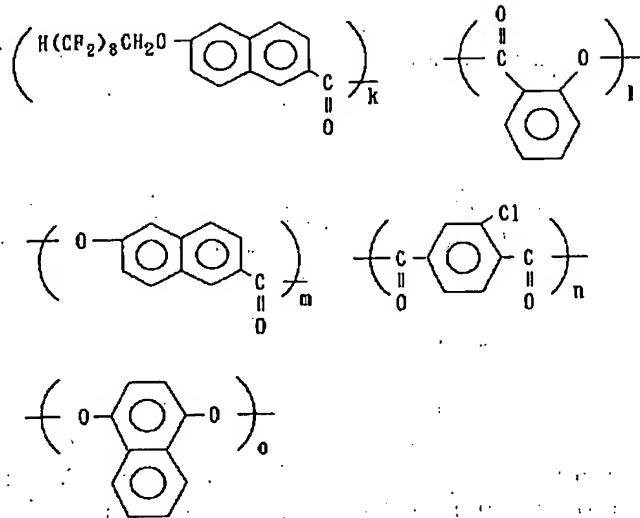
【化52】

(26)

49

構造式 45

50



【0130】 $\circ = k/2 + n$
 $k/n = 80/60 \sim 2/99$ 、好ましくは $40/80 \sim 10/95$
 $1/m = 100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$

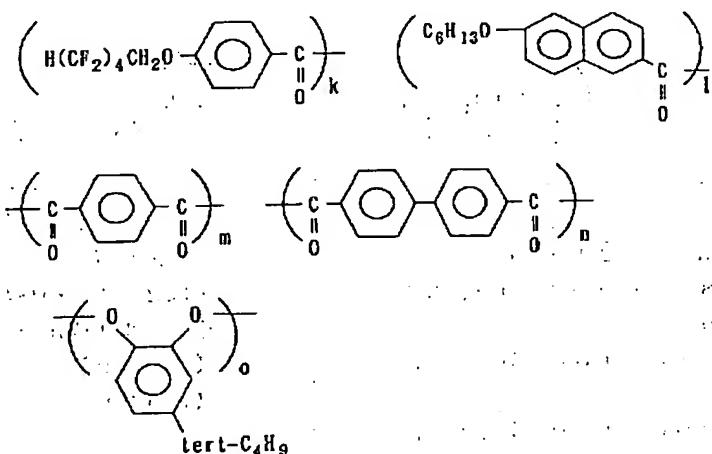
* $(1+m)/\circ = 20/10 \sim 1/10$ 、好ましくは $15/10 \sim 5/10$

⁴⁰ k, l, m, n, \circ はそれぞれモル組成比を示す。

【0131】

* 【化53】

構造式 46 :



【0132】 $\circ = k/2 + 1/2 + m + n$
 $(k+1)/(m+n) = 80/60 \sim 2/99$ 、好ましくは $40/80 \sim 10/95$
 $k/l = 100/0 \sim 0/100$ 、好ましくは $90/10 \sim 10/90$

$m/n = 100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$

⁴⁰ k, l, m, n, \circ はそれぞれモル組成比を示す。

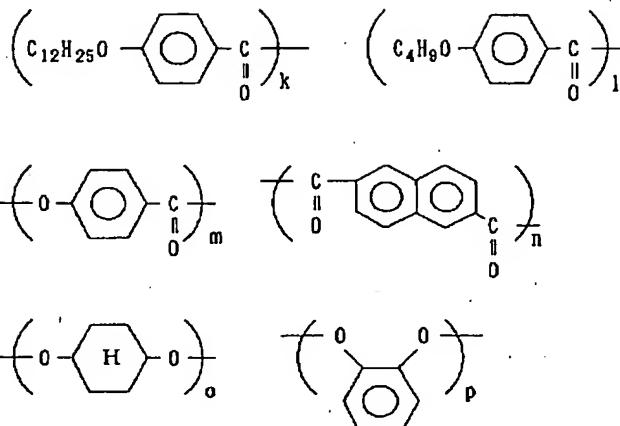
【0133】

【化54】

(27)

51
構造式 4.7

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【0134】 $\circ + p = k / 2 + l / 2 + n$
 $(k+1) / n = 80 / 60 \sim 2 / 99$ 、好ましくは $40 / 80 \sim 10 / 95$
 $k / l = 100 / 0 \sim 0 / 100$ 、好ましくは $90 / 10 \sim 10 / 90$
 $\circ / p = 100 / 0 \sim 0 / 100$ 、好ましくは $95 / 5 \sim 5 / 95$
 $m / n = 20 / 10 \sim 0 / 10$ 、好ましくは $15 / 10 \sim 5 / 10$

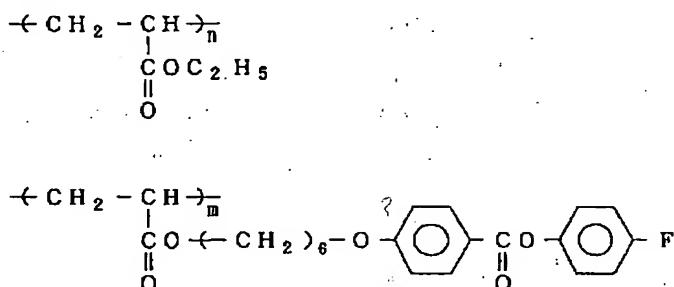
k, l, m, n, \circ, p はそれぞれモル組成比を示す。*

構造式 4.8

* 【0135】などが挙げられる。またホメオトロピック配向性の液晶性高分子としては、嵩高い置換基を有する芳香族基、長鎖アルキル基を有する芳香族基、フッ素原子を有する芳香族基などの置換基を有する単位を側鎖として持つ側鎖型液晶性高分子、例えばポリアクリレート、ポリメタクリレート、ポリシロキサン、ポリマロネート等の側鎖型液晶性高分子も挙げられる。以下に具体的な構造例を示す。

【0136】

【化55】

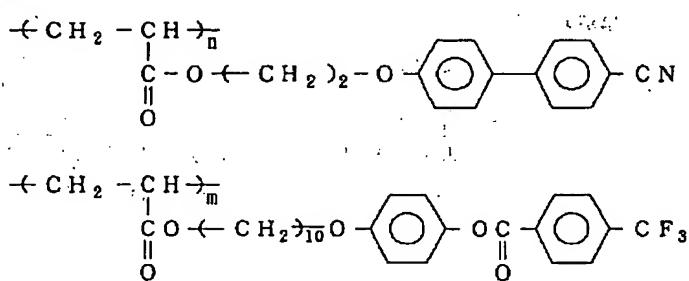


【0137】 $n / m = 80 / 20 \sim 20 / 80$ 、好ましくは $75 / 25 \sim 25 / 75$

※ 【0138】

※ 【化56】

構造式 4.9

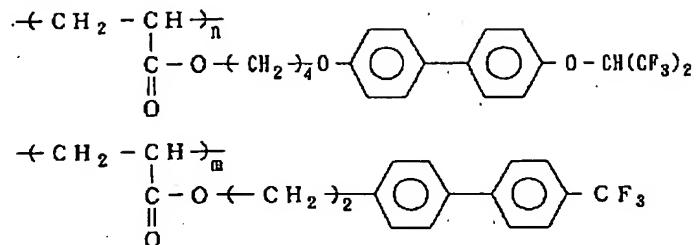


【0139】 $n / m = 80 / 20 \sim 20 / 80$ 、好ましくは $75 / 25 \sim 25 / 75$

【0140】

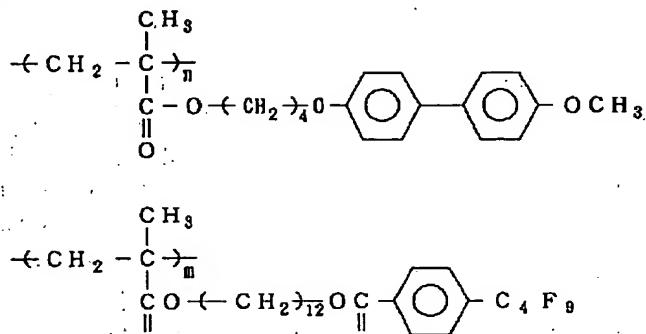
【化57】

(28)

53
構造式 5 0【0141】n/m=80/20~20/80、好まし \star 【0142】

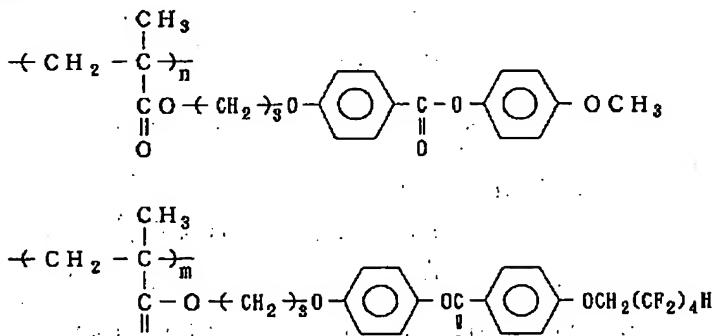
<は75/25~25/75 * 【化58】

構造式 5 1

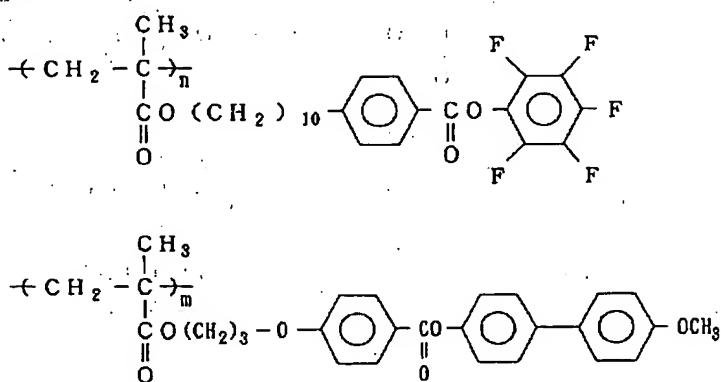
【0143】n/m=80/20~20/80、好まし \star 【0144】

<は75/25~25/75 * 【化59】

構造式 5 2

【0145】n/m=80/20~20/80、好まし \star 【0146】<は75/25~25/75 \star 【化60】

構造式 5 3

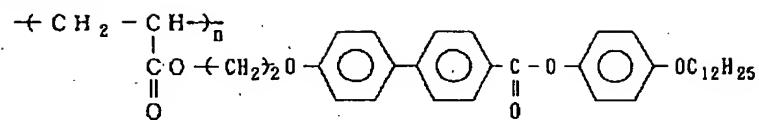
【0147】n/m=80/20~20/80、好まし \star <は75/25~25/75

(29)

55

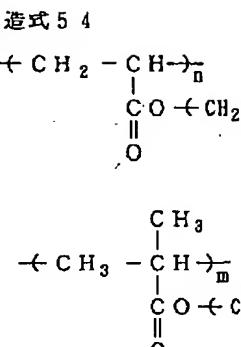
【0148】

構造式54



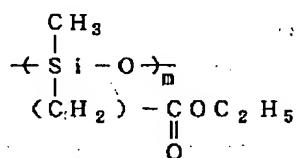
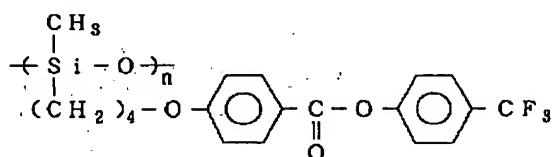
56

* * 【化61】

【0149】 $n/m = 80/20 \sim 20/80$ 、好まし
くは $75/25 \sim 25/75$ ※ 【0150】

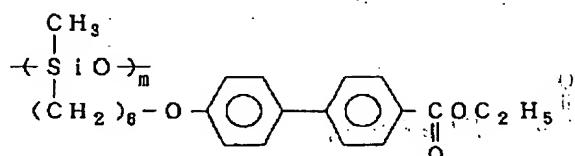
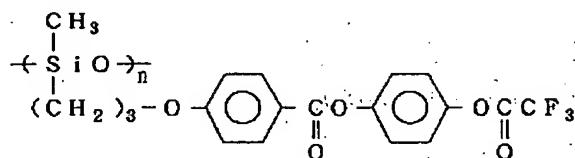
※ 【化62】

構造式55

【0151】 $n/m = 80/20 \sim 20/80$ 、好まし
くは $75/25 \sim 25/75$ ★ 【0152】

★ 【化63】

構造式56

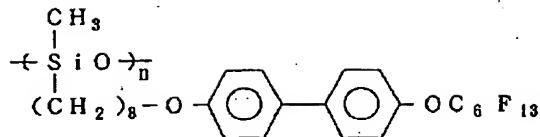
【0153】 $n/m = 80/20 \sim 20/80$ 、好まし
くは $75/25 \sim 25/75$ 【0154】

【化64】

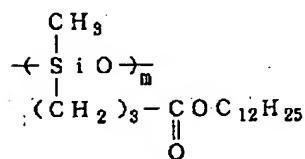
(30)

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構造式 5.7

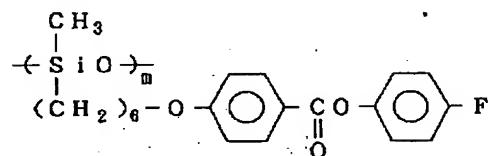
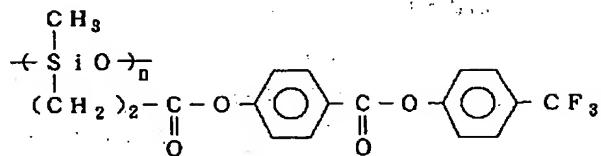


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【0155】n/m=80/20~20/80、好まし
くは75/25~25/75 * 【化65】

構造式 5.8

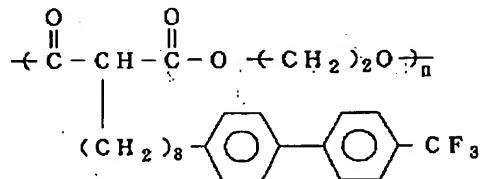


【0157】n/m=80/20~20/80、好まし
くは75/25~25/75

【0158】

【化66】

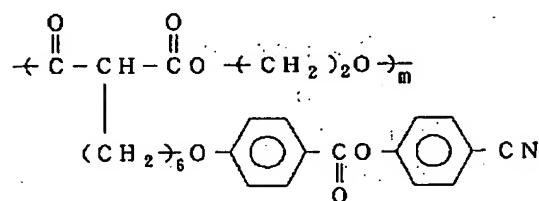
構造式 5.9



【0159】n/m=80/20~20/80、好まし
くは75/25~25/75

【0160】

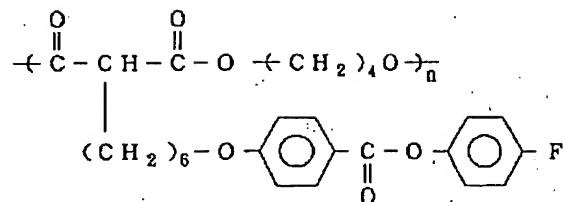
【化67】



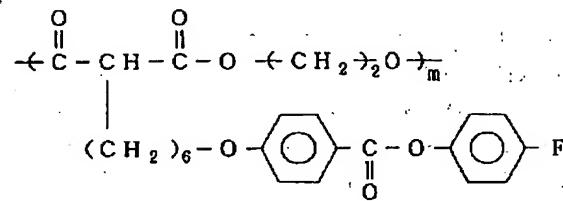
(31)

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構造式 6 0



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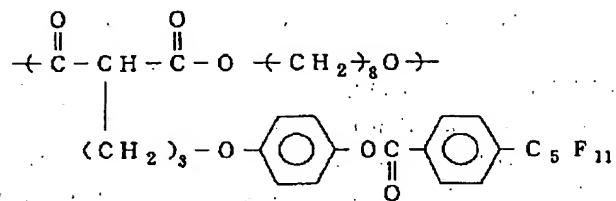


【0161】 n/m=80/20~20/80、好まし * 【0162】

くは75/25~25/75

* 【化68】

構造式 6 1

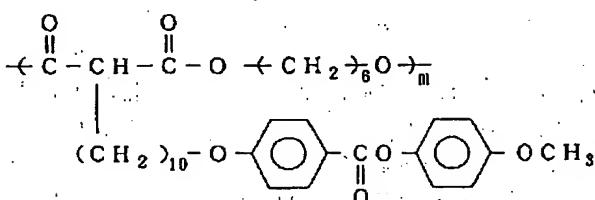
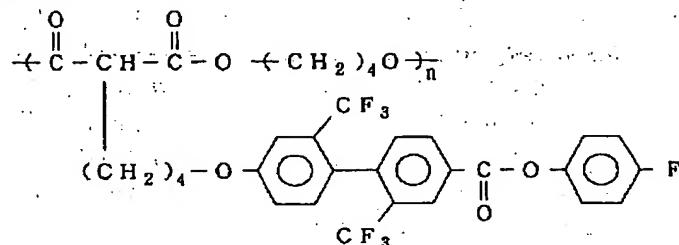


【0163】 n/m=80/20~20/80、好まし * 【0164】

くは75/25~25/75

* 【化69】

構造式 6 2

【0165】 n/m=80/20~20/80、好まし
くは75/25~25/75

【0166】 上記のホメオトロピック配向性液晶性高分子において、①の液晶性高分子の主鎖を構成する構造単位に嵩高い置換基を有する芳香族基、長鎖アルキル基を有する芳香族基、フッ素原子を有する芳香族基等を有する主鎖型液晶性高分子の場合、分子量は、各種溶媒中、たとえばフェノール/テトラクロロエタン(60/40

(重量比)) 混合溶媒中、30°Cで測定した対数粘度が通常0.05~2.0、好ましくは0.07~1.0の範囲である。対数粘度が0.05より小さい場合、補償フィルムの機械的強度が弱くなる恐れがある。また、2.0より大きい場合、ホメオトロピック配向性が失われる恐れがある。また2.0より大きい場合には、液晶状態において粘性が高くなりすぎる恐れがあり、ホメオトロピック配向したとしても配向に要する時間が長くな

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る可能性がある。しかも後述にて説明する補償フィルム製造時に、ネマチックハイブリッド配向が得られない恐れがある。

【0167】また②の高分子鎖の末端または両末端に、炭素数3～20の長鎖アルキル基または炭素数2～20の長鎖フルオロアルキル基などを有し、モノアルコールやモノカルボン酸などの官能性部位を一つ有する化合物から誘導される一官能性の単位を有する液晶性高分子の場合、分子量は、各種溶媒中、たとえばフェノール／テトラクロロエタン(60/40(重量比))混合溶媒中、30℃で測定した対数粘度が通常0.04～1.5、好ましくは0.06～1.0の範囲である。対数粘度が0.04より小さい場合、補償フィルムの機械的強度が弱くなる。また1.5より大きい場合、ホメオトロピック配向性が失われる恐れがある。また液晶状態において粘性が高くなりすぎる恐れがあり、ホメオトロピック配向したとしても配向に要する時間が長くなる可能性がある。しかも後述にて説明する補償フィルム製造時に、ネマチックハイブリッド配向が得られない恐れがある。

【0168】さらに側鎖型液晶性高分子の場合、分子量はポリスチレン換算重量平均分子量で通常1000～10万、好ましくは3000～5万の範囲が好ましい。分子量が1000より小さい場合、補償フィルムの機械的強度が弱くなる恐れがあり望ましくない。また、10万より大きい場合、ホメオトロピック配向性が失われる恐れがある。また10万より大きい場合には、該液晶性高分子の溶媒に対する溶解性が低下する恐れがあり、後述にて説明する補償フィルム製造の際に例えば塗布液の溶液粘度が高くなりすぎ均一な塗膜を得ることができない、といった問題を生じる恐れがあり望ましくない。

【0169】上記の液晶性高分子の合成法は、特に制限されるものではない。該液晶性高分子は、当該分野で公知の重合法で合成することができる。例えば液晶性ポリエステル合成を例にとれば、溶融重合法あるいは対応するジカルボン酸の酸クロライドを用いる酸クロライド法で合成することができる。

【0170】当該液晶性高分子を合成する際において、一官能性の構造単位は、先に説明したモノアルコール、モノカルボン酸化合物およびこれらの機能性誘導体、具体的にはアセチル化物、ハロゲン化物などとして重合反応に供される。該一官能性構造単位の液晶性高分子、具体的には液晶性ポリエステル中に占める含有率は、ヒドロキシカルボン酸構造単位を除いた残りの構成成分量中、モル分率で2/20.1～80/240の範囲である。より好ましくは、10/20.5～20/220の範囲である。一官能性構造単位の含有率が、2/21.0

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(モル分率)より小さい場合には、液晶性ポリエステルがホメオトロピック配向性を示さない恐れがある。また、一官能性構造単位の含有率が80/240(モル分率)より大きい場合には、液晶性ポリエステルの分子量が所望の値まで上がらない恐れがある。また補償フィルムを作製した場合、該フィルムの機械的強度が弱くなり好ましくない。なお、一官能性の構造単位の含有率は、モノマー成分の仕込み量に応じたものである。

【0171】また正の一軸性を示す液晶性高分子としては、先に説明したように該ホメオトロピック配向性の液晶性高分子以外に、他の配向を示す液晶性高分子や、何ら液晶性を示さない非液晶性高分子などを適宜混合して組成物として用いてもよい。該組成物として用いることにより、

- ① その組成比の調節でネマチックハイブリッド配向の平均チルト角を自在に制御することができる、
- ② ネマチックハイブリッド配向の安定化を図ることができる、

といった利点がある。ただし、混合して組成物とした液晶性高分子が、光学的に正の一軸性を示し、該液晶性高分子の液晶状態においてネマチックハイブリッド配向を形成するものでなければ本発明に用いる補償フィルムは得られない。なお組成物として用いる際には、上記にて説明したホメオトロピック配向性の液晶性高分子を5重量%以上含有することが望ましい。5重量%より少ない場合、ネマチックハイブリッド配向が得られない恐れがある。

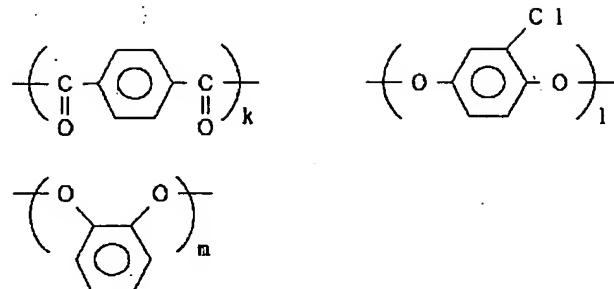
【0172】混合することができる当該高分子としては、ホメオトロピック配向性の液晶性高分子との相溶性

の観点から、通常はホメオトロピック配向性以外の配向を示す液晶性高分子を適宜混合する。用いられる液晶性高分子の種類としては、主鎖型液晶性高分子；例えばポリエステル、ポリイミド、ポリアミド、ポリエステル、ポリカーボネート、ポリエスチルイミド等、側鎖型液晶性高分子；例えばポリアクリレート、ポリメタクリレート、ポリシロキサン、ポリマロネート等を例示することができる。ホメオトロピック配向性の液晶性高分子との相溶性を有するものならば特に限定されないが、なかでもホモジニアス配向性液晶性高分子、より具体的にはホモジニアス配向性のポリエステル、ポリアクリレート、およびポリメタクリレート等が好ましい。なかでも先に例示した（〔化4〕）オルソ置換芳香族単位を主鎖に有する液晶性ポリエステルが最も好ましい。以下にホモジニアス配向性を示す液晶性高分子の具体的な構造例を示す。

【0173】

〔化70〕

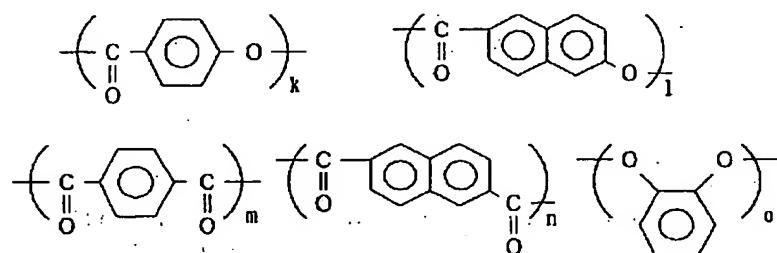
(33)

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構造式 6.3【0174】 $k = l + m$ $1/m = 80/20 \sim 20/80$ 、好ましくは $75/25 \sim 25/75$ * k, l, m はそれぞれモル組成比を示す。

【0175】

* 【化7.1】

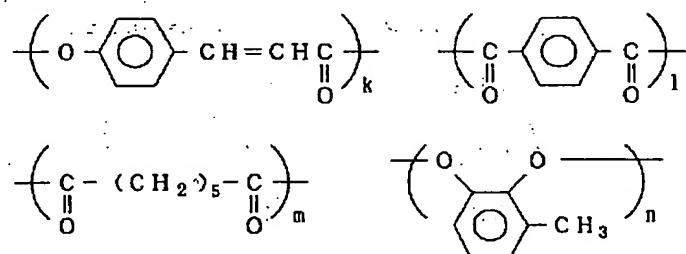
構造式 6.4

【0176】 $o = m + n$ $(k+1)/o = 20/10 \sim 0/10$ 、好ましくは $15/10 \sim 0/10$ $m/n = 100/0 \sim 0/100$ 、好ましくは $98/2 \sim 0/100$ ※ $\sim 2/98$ * k, l, m, n, o はそれぞれモル組成比を示す。

【0177】

【化7.2】

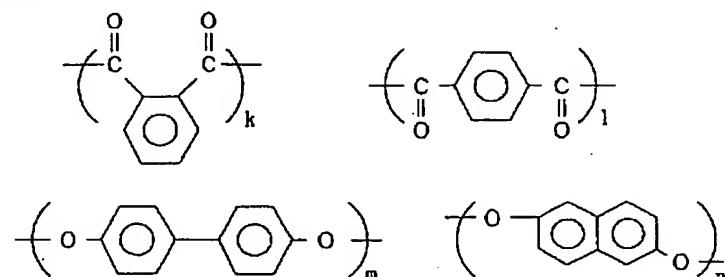
構造式 6.5

【0178】 $n = l + m$ $k/m = 20/10 \sim 0/10$ 、好ましくは $15/10 \sim 0/10$ * k, l, m, n はそれぞれモル組成比を示す。

【0179】

★ 【化7.3】

構造式 6.6

【0180】 $k + l = m + n$ so $k/l = 100/0 \sim 0/100$ 、好ましくは $95/5$

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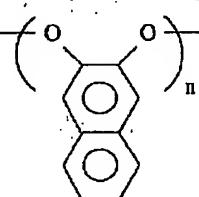
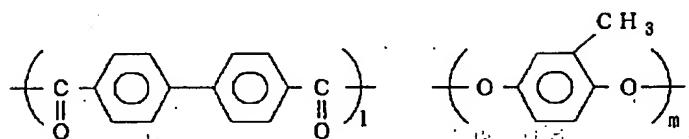
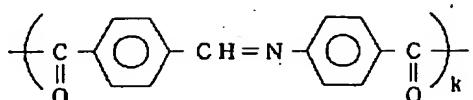
 $\sim 5/95$ $m/l = 100/0 \sim 0/100$ 、好ましくは $95/5$ $\sim 5/95$ * k, l, m, n はそれぞれモル組成比を示す。

【0181】

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* 【化74】

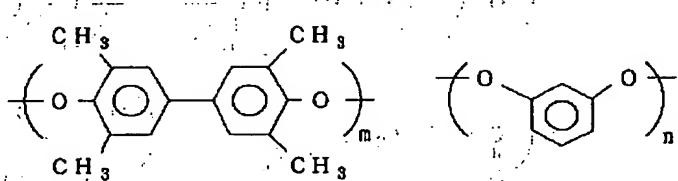
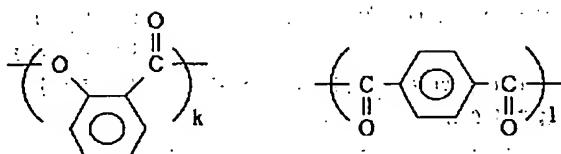
構造式 6.7

【0182】 $k+l=m+n$ $k/l = 100/0 \sim 0/100$ 、好ましくは $95/5$ $\sim 5/95$ $m/n = 100/0 \sim 0/100$ 、好ましくは $95/5$ *20※ $\sim 5/95$ * k, l, m, n はそれぞれモル組成比を示す。

【0183】

【化75】

構造式 6.8

【0184】 $l=m+n$ $k/l = 1.5/10 \sim 0/10$ 、好ましくは $1.0/10$ $\sim 0/10$ $m/n = 100/0 \sim 0/100$ 、好ましくは $95/5$ $\sim 5/95$ * k, l, m, n はそれぞれモル組成比を示す。】

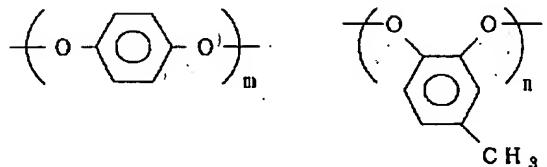
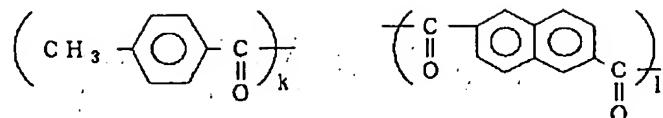
【0185】

【化76】

(35)

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構造式 6.9

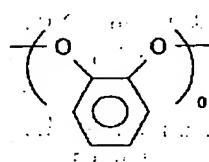
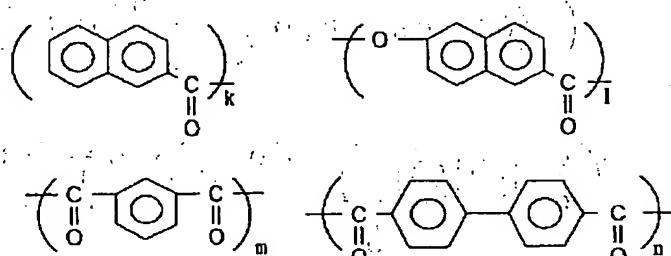


【0186】 $m+n=k/2+1$
 $k/l=40/80 \sim 0/100$ 、好ましくは $20/90 \sim 0/100$
 $m/n=100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$

* $\sim 5/9.5$
 k, l, m, n はそれぞれモル組成比を示す。

【0187】 【化77】

構造式 7.0



【0188】 $o=k/2+m+n$
 $k/(m+n)=40/80 \sim 0/100$ 、好ましくは
 $20/90 \sim 0/100$
 $m/n=100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$

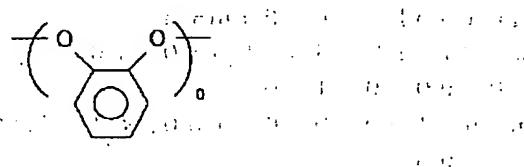
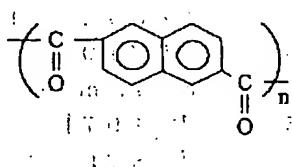
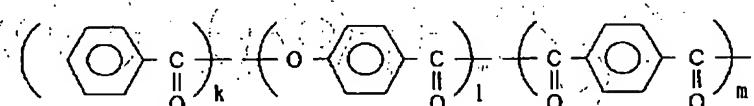
* $1/o=20/10 \sim 0/10$ 、好ましくは $15/10 \sim 5/10$

k, l, m, n, o はそれぞれモル組成比を示す。

【0189】

【化78】

構造式 7.1



【0190】 $o=k/2+m+n$
 $k/(m+n)=40/80 \sim 0/100$ 、好ましくは
 $20/90 \sim 0/100$
 $m/n=100/0 \sim 0/100$ 、好ましくは $95/5 \sim 5/95$

* $5/95$

$1/o=20/10 \sim 0/10$ 、好ましくは $15/10 \sim 5/10$

k, l, m, n, o はそれぞれモル組成比を示す。

(36)

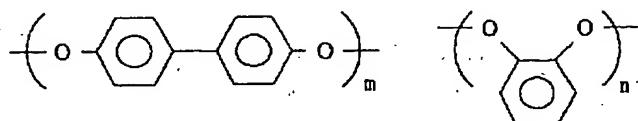
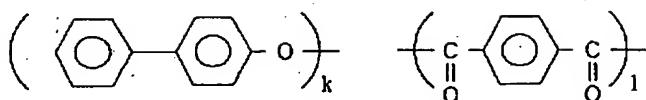
69

【0191】

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* * 【化79】

構造式7-2

【0192】 $l = k/2 + m + n$

※~5/95

 $k/(m+n) = 40/80 \sim 0/100$ 、好ましくは k, l, m, n はそれぞれモル組成比を示す。

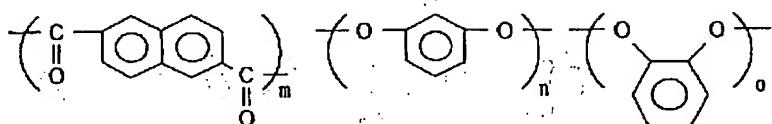
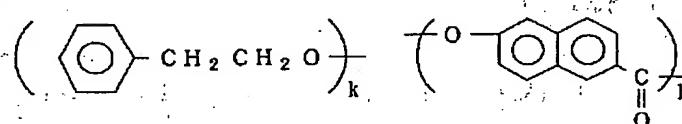
20/90~0/100

【0193】

 $n/m = 100/0 \sim 0/100$ 、好ましくは95/5※

【化80】

構造式7-3

【0194】 $m = k/2 + n + o$ ★ $l/m = 20/10 \sim 0/10$ 、好ましくは15/10 $k/(n+o) = 40/80 \sim 0/100$ 、好ましくは

~5/10

20/90~0/100

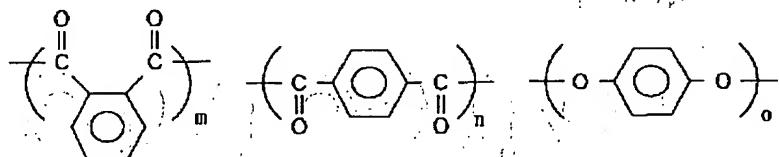
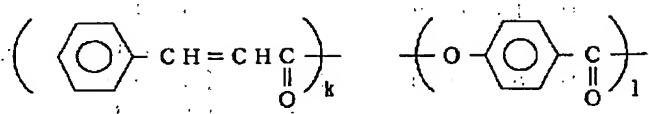
 k, l, m, n, o はそれぞれモル組成比を示す。 $n/o = 100/0 \sim 0/100$ 、好ましくは95/5

【0195】

~5/95

★³⁰ 【化81】

構造式7-4

【0196】 $o = k/2 + m + n$

1/o = 20/10~0/10、好ましくは15/10

 $k/(m+n) = 40/80 \sim 0/100$ 、好ましくは

~5/10

20/90~0/100

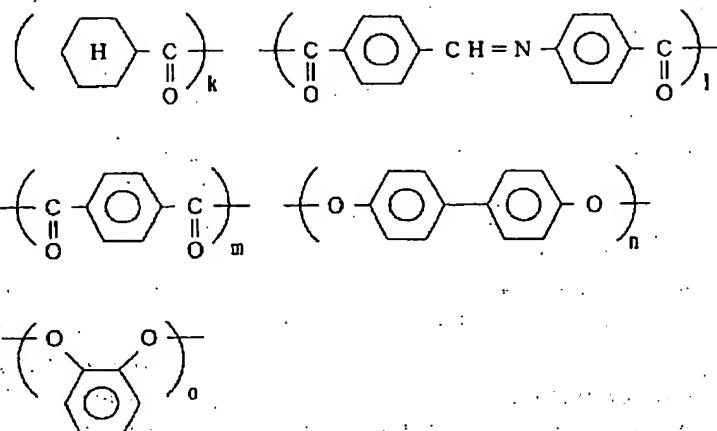
 k, l, m, n, o はそれぞれモル組成比を示す。 $m/n = 100/0 \sim 0/100$ 、好ましくは95/5

【0197】

~5/95

【化82】

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構造式 75【0198】 $n+o=k/2+1+m$

$k/(1+m)=40/80 \sim 0/100$ 、好ましくは

$20/90 \sim 0/100$

$1/m=100/0 \sim 0/100$ 、好ましくは $95/5$

$\sim 5/95$

$n/o=100/0 \sim 0/100$ 、好ましくは $95/5$

$\sim 5/95$

k, l, m, n, oはそれぞれモル組成比を示す。

【0199】これらの分子量は、主鎖型液晶性高分子の場合には、各種溶媒中、たとえばフェノール/テトラクロロエタン ($60/40$ (重量比))、混合溶媒中、30°Cで測定した対数粘度が通常 $0.05 \sim 3.0$ が好ましく、さらに好ましくは $0.07 \sim 2.0$ の範囲である。対数粘度が 0.05 より小さい場合、補償フィルムの機械的強度が弱くなる恐れがある。また、 3.0 より大きい場合、ホメオトロピック配向を阻害する、あるいは液晶形成時の粘性が高くなりすぎ、配向に要する時間が長くなる、といった恐れがあるので望ましくない。【0200】また側鎖型高分子液晶の場合、分子量はポリスチレン換算重量平均分子量で通常 $5000 \sim 20$ 万、好ましくは 1 万～1.5 万の範囲が好ましい。分子量が 5000 より小さい場合、補償フィルムの機械的強度が弱くなる恐れがある。また、 20 万より大きい場合、ポリマーの溶媒に対する溶解性が低下する、塗布液の溶液粘度が高くなりすぎ均一塗膜を得ることができないなどの製膜上の問題点を生じる恐れがあり望ましくない。

【0201】またホモジニアズ配向性の判定は、ホメオトロピック配向性の判定と同様に、シリコン処理、ラビング処理、一軸延伸処理などの表面処理を施していない該基板を用いて行う。該基板上に液晶性高分子層を形成し、その配向状態によってホモジニアズ配向性を示すか否かの判定を行う。

【0202】上記の液晶性高分子の合成法は、特に制限されるものではない。該液晶性高分子は、当該分野で公知の重合法で合成することができる。例えばポリエステル合成を例に取れば、溶融重合法あるいは対応するジカ

ルボン酸の酸クロライドを用いる酸クロライド法で合成することができる。

【0203】上記の如き正の一軸性を有する液晶性高分子を用いて、均一にネマチックハイブリッド配向を固定化した補償フィルムを得るには、以下に説明する配向基板および各工程を踏むことが本発明において望ましい。

【0204】先ず、配向基板について説明する。正の一軸性の液晶性高分子を用いてネマチックハイブリッド配向を得るために、該液晶性高分子層の上下を異なる界面で挟むことが望ましい。上下を同じ界面で挟んだ場合には、該液晶性高分子層の上下界面における配向が同一となってしまい、ネマチックハイブリッド配向を得ることが困難となってしまう。

【0205】具体的な態様としては、一枚の配向基板と空気界面とを利用することとする。具体的には、液晶性高分子層の下界面を配向基板に、また該液晶性高分子層の上界面を空気に接するようにする。上下に界面の異なる配向基板を用いることもできるが、製造プロセス上、一枚の配向基板と空気界面とを利用するのが望ましい。

【0206】本発明に用いることのできる配向基板は、液晶の傾く向き (ダイレクターの配向基板への投影) を規定できるように、異方性を有していることが望ましい。液晶の傾く向きを規定できない場合には、無秩序な方位に傾いた配向しか得ることができない (ダイレクターを該基板へ投影したベクトルが無秩序になる)。

【0207】上記配向基板として、具体的には面内の異方性を有しているものが望ましく、ポリイミド、ポリアミドイミド、ポリアミド、ポリエーテルイミド、ポリエーテルエーテルケトン、ポリエーテルケトン、ポリケトンサルファイド、ポリエーテルスルファン、ポリスルファン、ポリフェニレンサルファイド、ポリフェニレンオキサイド、ポリエチレンテレフタレート、ポリブチレンテレフタレート、ポリエチレンナフタレート、ポリアセタール、ポリカーボネート、ポリアリレート、アクリル樹脂、ポリビニルアルコール、ポリプロピレン、セルロース系プラスチックス、エポキシ樹脂、フェノール樹脂

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などのプラスチックフィルム基板および一軸延伸プラスチックフィルム基板、表面にスリット状の溝を付けたアルミ、鉄、銅などの金属基板、表面をスリット状にエッチング加工したアルカリガラス、ホウ珪酸ガラス、フリンクガラスなどのガラス基板、などである。

【0208】本発明においては上記プラスチックフィルム基板にラビング処理を施したラビングプラスチックフィルム基板、またはラビング処理を施したプラスチック薄膜、例えばラビングポリイミド膜、ラビングポリビニルアルコール膜などを有する上記各種基板、さらに酸化珪素の斜め蒸着膜などを有する上記各種基板なども用いることができる。

【0209】上記各種配向基板において、ネマチックハイブリッド配向に形成せしめるのに好適な該基板としては、ラビングポリイミド膜を有する各種基板、ラビングポリイミド基板、ラビングポリエーテルエーテルケトン基板、ラビングポリエーテルケトン基板、ラビングポリエーテルスルファン基板、ラビングポリフェニレンサルファイド基板、ラビングポリエチレンテレフタレート基板、ラビングポリエチレンナフタレート基板、ラビングポリアリレート基板、セルロース系プラスチック基板を挙げることができる。また、これらの基板に施されたラビング方向は、先に説明した補償フィルムのチルト方向に通常対応する。

【0210】本発明の液晶表示素子に用いられる補償フィルムは、上述にて説明したように該フィルムの上面と下面とで液晶性高分子のダイレクターとフィルム平面とのなす角度が異なる。配向基板に接したフィルム面の界面近傍における該角度は、その配向処理の方法や液晶性高分子の種類によって0度以上50度以下または60度以上90度以下のどちらかの角度範囲に調節される。通常、配向基板に接したフィルム面の界面近傍における該液晶性高分子のダイレクターとフィルム平面とのなす角度を0度以上50度以下の角度範囲に調整する方が製造プロセス上望ましい。

【0211】該補償フィルムは、上記の如き配向基板上に均一に光学的に正の一軸性を示す液晶性高分子を塗布し、次いで均一配向過程、配向形態の固定化過程を経て得られる。該液晶性高分子の配向基板への塗布は、通常該液晶性高分子を各種溶媒に溶解した溶液状態または該液晶性高分子を溶融した溶融状態で行うことができる。製造プロセス上、溶液塗布が望ましい。

【0212】溶液塗布は、液晶性高分子を適当な溶媒に溶かし、所定濃度の溶液を調製する。上記溶媒としては、正の一軸性の液晶性高分子の種類(組成比など)によって一概には言えないが、通常はクロロホルム、ジクロロメタン、四塩化炭素、ジクロロエタン、テトラクロロエタン、トリクロロエチレン、テトラクロロエチレン、クロロベンゼン、オルソジクロロベンゼンなどのハロゲン化炭素類、フェノール、パラクロロフェノー

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ルなどのフェノール類、ベンゼン、トルエン、キシレン、メトキシベンゼン、1,2-ジメトキベンゼンなどの芳香族炭化水素類、アセトン、酢酸エチル、tert-ブチルアルコール、グリセリン、エチレングリコール、トリエチレングリコール、エチレングリコールモノメチルエーテル、ジエチレングリコールジメチルエーテル、エチセルソルブ、ブチルセルソルブ、2-ピロリドン、N-メチル-2-ピロリドン、ピリジン、トリエチルアミン、テトラヒドロフラン、ジメチルホルムアミド、ジメチルアセトアミド、ジメチルスルホキシド、アセトニトリル、ブチロニトリル、二硫化炭素など、およびこれらの混合溶媒、例えばハロゲン化炭素類とフェノール類との混合溶媒などが用いられる。

【0213】溶液の濃度は、用いる正の一軸性の液晶性高分子の溶解性や最終的に目的とする補償フィルムの膜厚に依存するため一概には言えないが、通常3~50重量%の範囲で使用され、好ましくは7~30重量%の範囲である。

【0214】上記の溶媒を用いて所望の濃度に調整した正の一軸性の液晶性高分子溶液を、次に上述にて説明した配向基板上に塗布する。塗布の方法としては、スピンドルコート法、ロールコート法、プリント法、浸漬引き上げ法、カーテンコート法などを採用できる。

【0215】塗布後、溶媒を除去し、配向基板上に膜厚の均一な液晶性高分子の層を形成させる。溶媒除去条件は、特に限定されず、溶媒がおむね除去でき、液晶性高分子の層が流動したり、流れ落ちたりさえしなければ良い。通常、室温での乾燥、乾燥炉での乾燥、温風や熱風の吹き付けなどをを利用して溶媒を除去する。

【0216】この塗布・乾燥工程の段階は、先ず基板上に均一に液晶性高分子の層を形成させることが目的であり、該液晶性高分子は、まだネマチックハイブリッド配向を形成していない。次の熱処理工程により、モノドメインなネマチックハイブリッド配向を完成させる。

【0217】熱処理によってネマチックハイブリッド配向を形成するにあたって、正の一軸性の液晶性高分子の粘性は、界面効果による配向を助ける意味で低い方が良い。従って熱処理温度は高い方が望ましい。また液晶性高分子によつては、得られる平均チルト角が熱処理温度により異なることがある。その場合には、目的に応じた平均チルト角を得るために熱処理温度を設定する必要がある。例えば、あるチルト角を有する配向を得るために比較的低い温度で熱処理を行う必要が生じた場合、低い温度では液晶性高分子の粘性が高く、配向に要する時間が長くなる。そのような場合には、一旦高温で熱処理し、モノドメインな配向を得た後に、段階的、もしくは徐々に熱処理の温度を目的とする温度まで下げる方法が有効となる。いずれにせよ、用いる光学的に正の一軸性を示す液晶性高分子の特性に従い、ガラス転移点以上の温度で熱処理する事が望ましい。熱処理温度は、通常50

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0°C～300°Cの範囲、特に100°C～260°Cの範囲が好適である。

【0218】また配向基板上において、液晶性高分子が十分な配向をするために必要な熱処理時間は、用いる該液晶性高分子の種類（例えば組成比など）、熱処理温度によって異なるため一概にはいえないが、通常10秒～120分の範囲、特に30秒～60分の範囲が好ましい。10秒より短い場合、配向が不十分となる恐れがある。また120分より長い場合には、生産性が低下する恐れがあり望ましくない。

【0219】このようにして、まず液晶状態で配向基板上全面にわたって均一なネマチックハイブリッド配向を得ることができる。

【0220】なお、上記の熱処理工程において、液晶性高分子をネマチックハイブリッド配向させるために磁場や電場を利用しても特に構わない。しかし、熱処理しつつ磁場や電場を印加した場合、印加中は均一な場の力が液晶性高分子に働くために、該液晶のダイレクターは一定の方向を向きやすくなる。すなわち、本発明の如くダイレクターがフィルムの膜厚方向によって異なる角度を形成しているネマチックハイブリッド配向は得られ難くなる。一旦ネマチックハイブリッド配向以外、例えばホメオトロピック、ホモジニアス配向またはそれ以外の配向を形成させた後、場の力を取り除けば熱的に安定なネマチックハイブリッド配向を得ることができるが、プロセス上特にメリットはない。

【0221】こうして液晶状態において形成したネマチックハイブリッド配向を、次に当該液晶性高分子の液晶転移点以下の温度に冷却することにより、該配向の均一性を全く損なわずに固定化できる。

【0222】上記冷却温度は、液晶転移点以下の温度であれば特に制限はない。たとえば液晶転移点より10°C低い温度において冷却することにより、均一なネマチックハイブリッド配向を固定化することができる。冷却の手段は、特に制限はなく、熱処理工程における加熱雰囲気中から液晶転移点以下の雰囲気中、例えば室温中に出すだけで固定化される。また、生産の効率を高めるために、空冷、水冷などの強制冷却、除冷を行ってもよい。ただし正の一軸性の液晶性高分子によっては、冷却速度によって得られる平均チルト角が若干異なることがある。このような該液晶性高分子を使用し、厳密に平均チルト角を制御する必要が生じた際には、冷却操作も適宜冷却条件を考慮して行うことが好ましい。

【0223】次いで、ネマチックハイブリッド配向のフィルム膜厚方向における角度制御について説明する。液晶性高分子のダイレクターとフィルム平面との成す角度は、使用する液晶性高分子の種類、組成比などや、配向基板、熱処理条件などを適宜選択することにより所望の角度にそれぞれ制御することができる。また、ネマチックハイブリッド配向を固定化した後でも、例えばフィル

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ム表面を均一に削る、溶剤に浸してフィルム表面を均一に溶かす、などといった方法を用いることにより所望の角度に制御することができる。なおこの際に用いられる溶剤は、液晶性高分子の種類や、配向基板の種類によって適宜選択しなければならない。

【0224】以上の工程によって得られる補償フィルムは、ネマチックハイブリッド配向という配向形態を均一に配向・固定化したものであり、また、該配向を形成しているので、該フィルムの上下は等価ではなく、また面内方向にも異方性がある。

【0225】また該補償フィルムを上述にて説明したようにTN液晶セルと上側および／または下側偏光板の間に配置する際の使用形態として

- ①配向基板を該フィルムから剥離して、補償フィルム単体で用いる、
- ②配向基板上に形成したそのままの状態で用いる、
- ③配向基板とは異なる別の基板に補償フィルムを積層して用いる、

という形態が挙げられる。なお②、③の状態で用いる場合、配向基板がネマチックハイブリッド配向を得るために必要なものではあるが、TN-LCDとして好ましくない影響を与える該基板を用いた際には、その配向基板をネマチックハイブリッド配向固定化後に除去することができる。本発明に用いられる配向固定化後の補償フィルムは、配向基板を除去しても配向乱れなどが起こることはない。以上、本発明の液晶表示装置においては、いずれの形態を有する補償フィルムであってもよい。

【0226】また該補償フィルムは、表面保護、強度増加、環境信頼性向上などの目的のために透明プラスチックフィルムなどの保護層を設けることもできる。また保護層として光学性質上好ましい基板、例えばポリメタクリレート、ポリカーボネート、ポリビニルアルコール、ポリエーテルスルфон、ポリスルfon、ポリアリレート、ポリイミド、アモルファスポリオレフィン、トリアセチルセルロースなどのプラスチック基板を光学グレードの接着剤または粘着剤を介して貼り合わせて用いることができる。

【0227】次に、本発明の補償フィルムを先に説明したTN液晶セルと組み合わせる場合の配置について具体的に説明する。本補償フィルムの配置位置は偏光板とTN液晶セルとの間であればよく、1枚または複数枚の補償フィルムを配置することができる。本発明では、1枚または2枚の補償フィルムを用いて視野角補償を行うことが実用上好ましい。3枚以上の補償フィルムを用いても、視野角補償は可能であるが、コストアップに繋がるためあまり好ましいとはいえない。具体的な配置位置を例示すると以下のようになる。ただし、これらはあくまで代表的な配置位置であり本発明はこれらに限定されるものではない。

【0228】先ず、本発明における補償フィルムのチル

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ト方向とは、該フィルムの上下2面の内、該液晶性高分子のダイレクターとフィルム平面との成す角度がより小さな面における該液晶性高分子のダイレクターの投影方向と定義する。具体的には、例えば図1において該補償フィルムの上下2面をb面、c面と仮定する。この補償フィルムのb面側およびc面側における液晶性高分子のダイレクターとフィルム平面との成す角度は、b面側の角度>c面側の角度の関係である。次いで該補償フィルムのb面からフィルム膜厚方向にc面を見た場合に、b面側のダイレクターとc面側のダイレクターとの成す角度が鋭角となる方向で、かつb面側のダイレクターとc面側のダイレクターのフィルム平面に対する投影成分とが平行となる方向を本発明では補償フィルムのチルト方向と定義する。

【0229】次いでTN液晶セルのプレチルト方向を以下のように定義する。通常TN液晶セル中のネマチック液晶は、図2の如くセル基板界面に対して平行ではなく、ある角度をもって傾いている（ネマチック液晶のツイスト角が0度の場合）。この状態において、該液晶のダイレクターと液晶セル基板平面との成す角度が鋭角である方向で、かつ該ダイレクターの投影成分が平行な方向を本発明ではプレチルト方向と定義する。したがってプレチルト方向は、図2に示すようにTN液晶セルにおける上下の液晶セル基板にそれぞれ一方向ずつ定義される。

【0230】先ず補償フィルム1枚を配置する場合について説明する。補償フィルムは偏光板とTN液晶セルの間に配置し、当該液晶セルの上面側でも良いし下面側でも良い。この配置の際、補償フィルムのチルト方向と、該補償フィルムが最も近接した液晶セル基板とは反対側のセル基板におけるプレチルト方向との成す角度を通常165～195度、好ましくは170～190度、特に好ましくは175～185度の範囲で配置する。すなわち補償フィルムをTN液晶セルの上面に配置している場合には、下側の該液晶セル基板におけるプレチルト方向との成す角度、また補償フィルムをTN液晶セルの下面に配置している場合には、上側液晶セル基板におけるプレチルト方向との成す角度を上記の角度範囲を満たさないように配置する。上記の角度範囲を満たさない場合には、十分な視野角補償効果が得られない。

【0231】次に、本補償フィルム2枚を配置する場合について説明する。2枚補償フィルムを配置する場合、2枚を同じ側、例えばTN液晶セルと上側偏光板との間または該液晶セルと下側偏光板との間に2枚配置しても良い。また上側および下側偏光板とTN液晶セルとの間にそれぞれ1枚配置しても良い。なお2枚の補償フィルムは、同一の光学パラメーターを有するものを用いても良いし、また光学パラメーターが異なる該フィルムを用いても良い。

【0232】上側および下側偏光板とTN液晶セルとの

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間にそれぞれ1枚ずつ配置する場合について説明する。該配置においては、それぞれの補償フィルムを上述の1枚を配置する場合と同様な配置にする。すなわち、それぞれの補償フィルムのチルト方向と補償フィルムが近接したTN液晶セルの基板とは反対のセル基板におけるプレチルト方向との成す角度を通常165～195度、好ましくは170～190度、特に好ましくは175～185度の範囲に配置する。

【0233】次いでTN液晶セルと上側または下側偏光板との間のどちらか一方に2枚の補償フィルムを配置する場合について説明する。なおTN液晶セルに最も近接した位置に配置する補償フィルムをフィルム1、該フィルム1と上側または下側偏光板との間に配置される補償フィルムをフィルム2と仮定する。該配置においてTN液晶セルに最も近接したフィルム1については、上述の1枚の補償フィルムを配置する条件と同様に配置する。すなわちフィルム1のチルト方向と、フィルム1が最も近接したTN液晶セルの基板とは反対側のセル基板におけるプレチルト方向との成す角度を通常165～195度、好ましくは170～190度、特に好ましくは175～185度の範囲で配置する。次いでフィルム1と上側または下側偏光板との間に配置されるフィルム2の配置条件について説明する。フィルム2は、フィルム1が最も近接したTN液晶セルのセル基板のプレチルト方向、すなわちフィルム1の配置条件の際に基準とした該セル基板とは逆のセル基板におけるプレチルト方向との成す角度を165～195度、好ましくは170～190度、特に好ましくは175～185度の範囲に配置する。

【0234】次いで偏光板の配置について説明する。通常、TN-LCDでは上下偏光板の透過軸が互いに直交または平行に配置する場合がある。また上下偏光板の透過軸が互いに直交するように配置する場合は、偏光板の透過軸と偏光板に近い側のTN液晶セル基板に施されたラビング方向とを直交、平行または45度の角度をなすように配置する場合がある。本発明の液晶表示装置においては、補償フィルム上に偏光板を装着する場合には、該配置は特に限定されず上記のうちいずれの配置であっても良い。なかでも本発明の液晶表示装置では、上下偏光板の透過軸が互いに直交し、かつ偏光板の透過軸と偏光板に近い側のTN液晶セル基板に施されたラビング方向とを直交または平行に配置することが望ましい。

【0235】以上、本発明は特定の光学パラメーターを有するTN液晶セルにネマチックハイブリッド配向を固定化した補償フィルムを配置することにより、TFT素子またはMIM素子を用いたツイステッドネマチック液晶表示装置として従来にない高コントラスト化、広視野角化が成された当該液晶表示装置を得ることができる。

【0236】

【実施例】以下に実施例を述べるが、本発明はこれらに

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制限されるものではない。なお実施例で用いた各分析法は以下の通りである。

(1) 液晶性高分子の組成の決定

ポリマーを重水素化クロロホルムまたは重水素化トリフルオロ酢酸に溶解し、400 MHzの¹H-NMR(日本電子製JNM-GX400)で測定し決定した。

(2) 対数粘度の測定

ウベローデ型粘度計を用い、フェノール/テトラクロロエタン(6/4.0重量比)混合溶媒中、30°Cで測定した。

(3) 液晶相系列の決定

DSC(Perkin-Elmer DSC-7)測定および光学顕微鏡(オリンパス光学(株)製BH2偏光顕微鏡)観察により決定した。

(4) 屈折率の測定

アッペ屈折計(アタゴ(株)製Type-4)により屈折率を測定した。

(5) 偏光解析

(株)溝尻光学工業製エリプソメーターDVA-36V WLDを用いて行った。

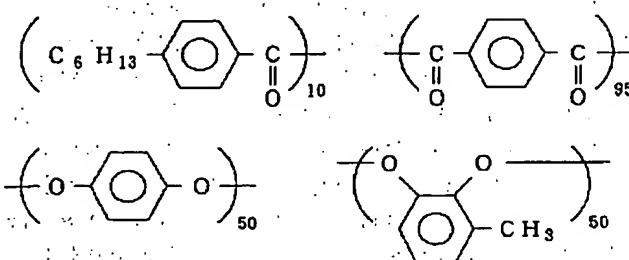
(6) 膜厚測定

(株)小坂研究所製高精度薄膜段差測定器ET-10を用いた。また、干渉波測定(日本分光(株)製紫外・可視・近赤外分光光度計V-570)と屈折率のデータから膜厚を求める方法も併用した。

【0237】参考例

〈液晶性ポリエステルの合成〉6-ヒドロキシ-2-ナフトエ酸 100 mmol、テレフタル酸 100 mmol、クロロヒドロキノン 50 mmol、tert-ブチルカテコール 50 mmol、および無水酢酸 600 mmolを用いて窒素雰囲気下で、140°Cで2時間アセチル化反応を行った。引き続き270°Cで2時間、280°Cで2時間、300°Cで2時間重合を行つ

式(1)



【0242】〈配向構造の確認操作②〉次いで基板上のフィルム2を5枚に切り分け、それぞれ一定時間クロロホルムを5wt%含むメタノール溶液に浸漬し、液晶層上面より溶出させた。浸漬時間を15秒、30秒、1分、2分、5分とした場合に、溶出せずに残った液晶層の膜厚は、それぞれ1.5 μm、1.2 μm、1.0 μm、0.8 μm、0.5 μmであった。図3、図4の光

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*た。次に得られた反応生成物をテトラクロロエタンに溶解したのち、メタノールで再沈殿を行って精製し、液晶性ポリエステル(式(1))40.0 gを得た。この液晶性ポリエステルの対数粘度は0.35、液晶相としてネマチック相をもち、等方相—液晶相転移温度は300°C以上、ガラス転移点は135°Cであった。

【0238】〈液晶性ポリエステルの配向性試験〉この液晶性ポリエステルを用い10wt%のフェノール/テトラクロロエタン混合溶媒(6/4重量比)溶液を調製した。この溶液を、ソーダガラス板上に、スクリーン印刷法により塗布し、乾燥し、230°Cで30分熱処理したのち、室温下で冷却・固定化した。膜厚20 μmの均一に配向したフィルム1を得た。コノスコープ観察したところ該液晶性ポリエステルが光学的に正の一軸性に示すことが判明した。また当該ポリエステルがホメオトロピック配向性を有することが判明した。

【0239】〈配向構造の確認操作①〉式(1)の液晶性ポリエステルの8wt%テトラクロロエタン溶液を調製し、ラビングポリイミド膜を有するガラス上にスピンドルコート法により塗布し、乾燥し、250°Cで30分間熱処理したのち、空冷し固定化した結果、フィルム2を得た。得られた基板上のフィルム2は、透明で配向欠陥はなく均一で膜厚は2.0 μmであった。

【0240】図3、図4に示した光学測定系を用いて、フィルム2を配向基板のラビング方向に傾けていき、リターデーション値を測定した。その結果、図5のような左右非対称でかつリターデーション値が0になる角度がない結果が得られた。この結果から、液晶性ポリエステルのダイレクターが基板に対して傾いており均一チルト配向(ダイレクターと基板表面のなす角が膜厚方向で一定な配向状態)ではないことが分かった。

【0241】

【化83】

学系を用いてθ=0度の場合のリターデーション値(正面リターデーション値)を測定し、膜厚とリターデーション値との関係を得た(図6)。図6から分かるように膜厚とリターデーション値は直線関係にはなく、このことからも均一チルト配向ではないことが分かった。図中の点線は均一チルト配向したフィルムにおいて観測される直線である。

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【0243】〈配向構造の確認操作③〉次に、式(1)の液晶性ポリエステルをラビングポリイミド膜を有する高屈折率ガラス基板(屈折率は1.84)上に、上記と同様な方法を用いて配向・固定化し、フィルム3を作製した。得られたフィルム3を用いて屈折率測定を行った。屈折計のプリズム面にガラス基板が接するようにフィルム3を配置した場合、フィルム面内の屈折率には異方性が有り、ラビング方向に垂直な面内の屈折率は1.56、平行な面内の屈折率は1.73であり、膜厚方向の屈折率はフィルム3の方向によらず1.56で一定であった。このことから、ガラス基板側では液晶性ポリエステルを構成する棒状の液晶分子は、基板に対して平行に平面配向していることが判明した。次に屈折率計のプリズム面にフィルム3の空気界面側が接するように配置した場合、面内の屈折率には異方性がなく屈折率は1.56で一定で、膜厚方向の屈折率はフィルム3の方向によらず1.73で一定であった。このことから、空気界面側では液晶性ポリエステルを構成する棒状の液晶分子が基板平面に対して垂直に配向していることが判明した。

【0244】以上の①から③の操作より、式(1)の液晶性ポリエステルから形成されたフィルムがネマチックハイブリッド配向を形成し、ラビングによる基板界面の規制力および空気界面の規制力により、図7に示したように配向しているものと推察した。

【0245】〈チルト方向の解析および配向基板界面におけるダイレクターと基板平面との成す角度の推定〉ラビングポリイミド膜を有する高屈折ガラス基板上に形成されたフィルム3の上に、もう一枚ラビングポリイミド膜を有するガラス基板をかぶせ密着させた。すなわちフィルム3を2枚のラビングポリイミド膜で挟んだ構成にした。なお、上下のラビング膜のラビング方向が互いに180度になるように配置した。この状態で230℃で30分間熱処理した。こうした得られた試料フィルムについて屈折率測定および偏光解析を行った。屈折率測定の結果、該試料フィルムの上下に関して同じ値が得られ、フィルム面内の屈折率はラビング方向に垂直な面内では1.56、平行な面内では1.73、該フィルムの膜厚方向では1.56であった。このことから基板の界面付近では試料フィルムの上下ともにダイレクターが基板平面に対して略平行であることが分かった。さらに偏光解析の結果、屈折率構造はほぼ正の一軸性であり、クリスタルローテーション法に基づき詳細な解析を行った結果、基板界面付近では、わずかにダイレクターは傾いていた。また基板平面とダイレクターとの成す角度は約3度であった。さらにダイレクターの傾く向きは、ラビング方向と一致していた(フィルムのチルト方向とラビング方向とは一致する)。

【0246】以上のことより、基板界面におけるダイレクターは、液晶性ポリエステルと配向基板界面の相互作

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用によってほぼ決まると考えると、前述の一枚の配向基板上に形成されたフィルム3の基板界面におけるダイレクターとフィルム平面との成す角度は3度であると推定される。

【0247】実施例1

参考例1で使用した液晶性ポリエステル(式(1))の5wt%のテトラクロロエタン溶液を調製した。該溶液をラビングポリイミド膜を有するガラス基板にスピンドルコート法により塗布し、溶媒を除去した。その後250℃で30分間熱処理した。その後、冷却し当該ポリエステルの配向を固定化した。こうして得られたガラス基板上のフィルム4は、ネマチックハイブリッド配向構造を有しており、透明で配向欠陥はなく、均一な膜厚(0.85μm)を有していた。また平均チルト角は44度であり、チルト方向はラビング方向と一致していた。

【0248】このラビングポリイミド膜を有するガラス基板上に形成したフィルム4を2枚用い、図8の軸配置となるようにTNセルの上下に配置した。なお当該セルの上下のフィルム1は、共に該フィルムのガラス基板側

をセル基板に近接するように配置した。使用したTNセルは、液晶材料としてZLI-4792($\Delta n=0.094$)を用い、セルパラメータはセルギャップ4.2μm、 $\Delta n \cdot d = 3.95 \text{ nm}$ 、ねじれ角90度(左ねじれ)、プレチルト角3度であった。またプレチルト方向は、液晶セル基板のラビング方向に一致していた。当該TNセルに対して、300Hzの矩形波で電圧を印加した。白表示0V、黒表示6Vの透過率の比(白表示)/(黒表示)をコントラスト比として、全方位からのコントラスト比測定を浜松ホトニクス(株)製EFP光学系DVS-3000'を用いて行い、等コントラスト曲線を描いた。その結果を図9に示した。

【0249】実施例2

式(2)、式(3)の液晶性ポリエステルを合成した。式(2)の液晶性ポリエステルの対数粘度は0.10、液晶相としてネマチック相を有し、等方相-液晶相転移温度は18.0℃であった。実施例1と同様の配向性試験を行った結果、式(2)の液晶性ポリエステルが、ホメオトロピック配向性を示し、光学的に正の一軸性を示すことが判明した。

【0250】式(3)の液晶性ポリエステルの対数粘度は0.18、液晶相としてネマチック相を有し、等方相-液晶相転移温度は30.0℃以上であった。実施例1と同様の配向性試験を行った結果、式(3)の液晶性ポリエステルが、ホモジニアス配向性を示すことが判明した。

【0251】式(2)、(3)の液晶性ポリエステルを5.0:5.0(重量比)で含有する8wt%のN-メチル-2-ピロリドン溶液を調製した。

【0252】当該溶液をラビング処理した幅40cmのポリエーテルエーテルケトンフィルム上にダイコート法

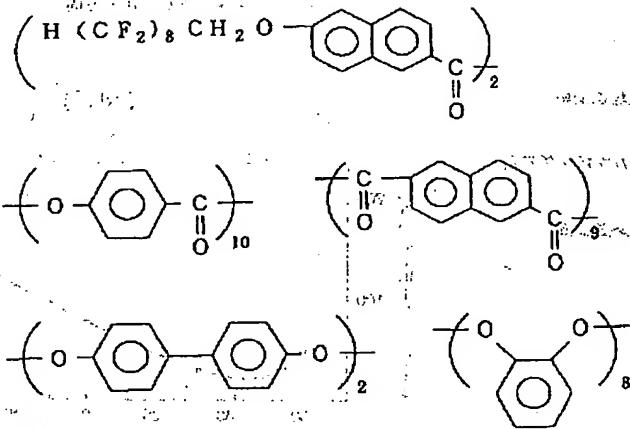
(43)

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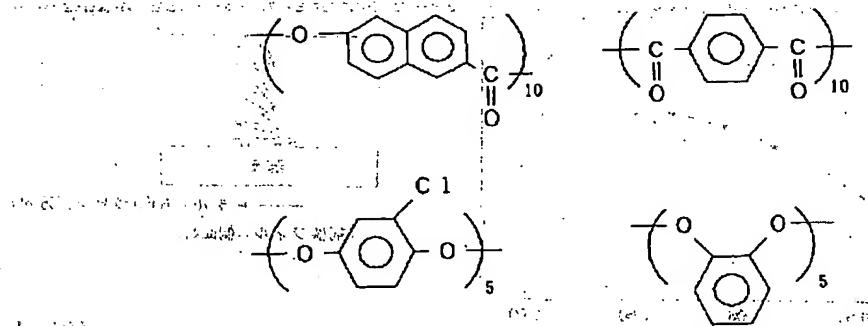
により長さ10mにわたって塗布し、120°Cの熱風で乾燥した後、220°Cで10分間熱処理を行った。その後、冷却し、当該ポリエステル組成物(式(9)、(10))のポリエステルを50:50(重量比)で含む組成物の配向を固定化した。

【0253】得られたフィルム5の表面に粘着剤を介してトリアセチルセルロースを貼り合わせ、次いで配向基板として用いたポリエーテルエーテルケトンフィルムを剥離、除去し、トリアセチルセルロースフィルム上にフィルム5を転写した。フィルム5の膜厚は0.60μ^{*10}。

式(2)



式(3)



【0255】比較例1フィルム4を使用しない以外はすべて実施例1と同様にして等コントラスト曲線を描いた。その結果を図11に示す。

【図面の簡単な説明】

【図1】本発明におけるチルト方向の概念図。

【図2】本発明におけるプレチルト方向の概念図。

【図3】補償フィルムのチルト角測定に用いた光学測定系の配置図。

【図4】補償フィルムのチルト角測定に用いた光学測定系における試料および偏光板の軸方位との関係。

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* m、膜厚方向の平均チルト角は35度であった。このトリアセチルセルロースフィルムに転写したフィルム5を2枚用い、図8に示した配置になるようにTNセルの上下に当該フィルムを1枚ずつ配置した。用いたTNセルは、実施例1で用いた当該セルと同様のものを使用した。実施例1と同様の方法にて全方位でのコントラスト比を測定した結果を図10に示した。

【0254】

【化84】

【図5】参考例における見かけのリターデーション値と試料の傾き角との関係。

【図6】参考例における補償フィルムの浸漬後の膜厚と正面での見かけのリターデーション値との関係。

【図7】補償フィルムの配向構造の概念図。

【図8】実施例1および2における、各光学素子の軸配置。

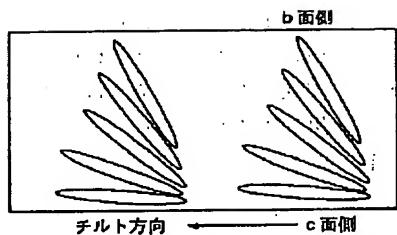
【図9】実施例1の等コントラスト曲線。

【図10】実施例2の等コントラスト曲線。

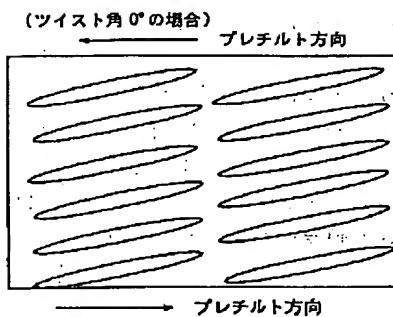
【図11】比較例1の等コントラスト曲線。

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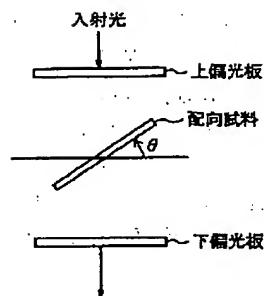
【図1】



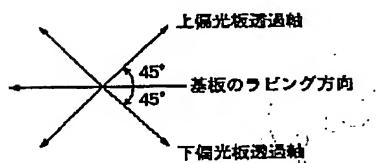
【図2】



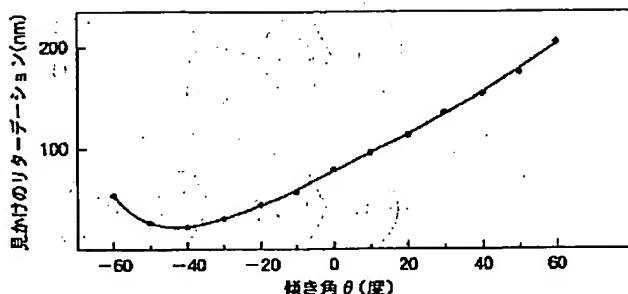
【図3】



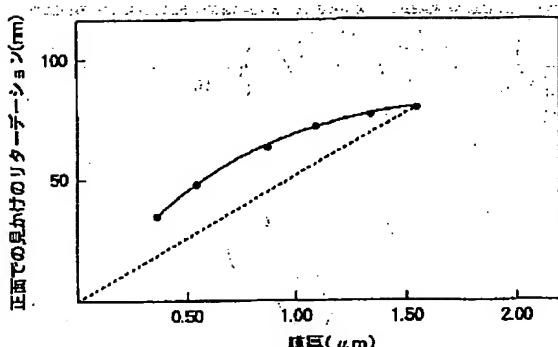
【図4】



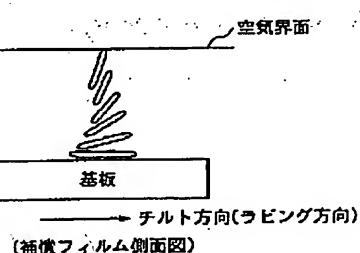
【図5】



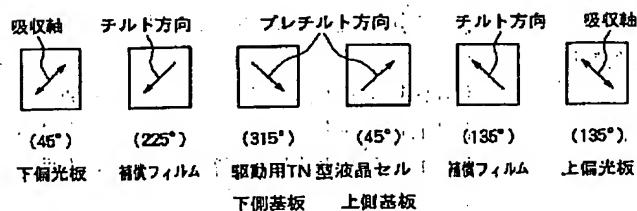
【図6】



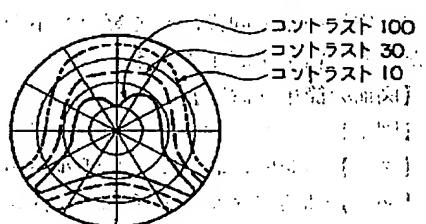
【図7】



【図8】

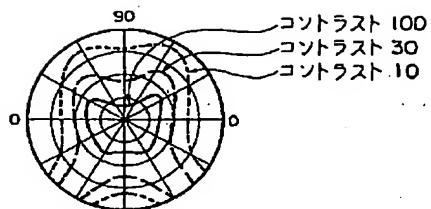


【図9】

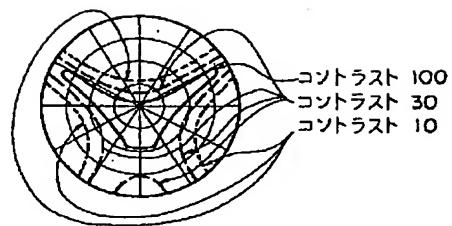


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【図10】



【図11】



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(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a twisted nematic liquid crystal display device which has its display contrast, gradation characteristics, and field angle characteristics of display colors improved.

SOLUTION: This device consists of a driving twisted nematic liquid crystal cell consisting of at least one compensation film which is formed of optically positive uniaxial liquid crystal macromolecules and has the nematic hybrid orientation that the liquid crystal macromolecules form in a liquid crystal state fixed, a couple of transparent substrates equipped with electrodes, and a nematic liquid crystal sandwiched between the substrates and two polarizing plates which are arranged above and below the liquid crystal cell. Here, the product ($\Delta n d$) of the refractive index anisotropy (Δn) of the nematic liquid crystal constituting the liquid crystal cell and the thickness (d) of the liquid crystal layer of the liquid crystal cell is 200 to 500 nm.

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[Claim(s)]

[Claim 1] The compensation film of at least one sheet which fixed the nematic hybrid orientation which it was substantially formed and the liquid crystallinity giant molecule concerned formed in the liquid crystal condition from the liquid crystallinity giant molecule in which optically uniaxial [forward] is shown optically. It consists of two polarizing plates with which the TSUISUTEDDO nematic mold liquid crystal cell for actuation which consists of nematic liquid crystals pinched between the transparency substrate of the couple equipped with the electrode and the substrate concerned, and the liquid crystal cell concerned are arranged up and down at least. And the TSUISUTEDDO nematic mold liquid crystal display characterized by a product (deltand) with the thickness (d) of the liquid crystal layer in the refractive-index anisotropy (deltan) and the liquid crystal cell concerned of the nematic liquid crystal which constitutes said liquid crystal cell being 200nm · 500nm or less.

[Detailed Description of the Invention]**[0001]**

[Field of the Invention] This invention relates to the Twisted Nematic mold liquid crystal display with which display contrast, the gradation property, and the angle-of-visibility property of a foreground color were improved.

[0002]

[Description of the Prior Art] the original features of LCD called a thin shape, a light weight, and a low power in the Twisted Nematic mold liquid crystal display (it is called TN-LCD for short below) of an active drive using a TFT component or an MIM component -- in addition, since it has the image quality which is equal to CRT when it sees from a transverse plane, it has spread widely as displays, such as a notebook computer, portable television, and a portable information terminal. However, in conventional TN-LCD, when it sees from across for the refractive-index anisotropy which a liquid crystal molecule has, or a foreground color changes, the problem of the angle of visibility that display contrast falls is not avoided in essence, but the amelioration is desired strongly, and various attempts for amelioration are made.

[0003] How (the halftone gray-scale method) to divide one pixel and to change the seal-of-approval electrical potential difference to each pixel by the fixed ratio, How (domain split plot experiment) to divide one pixel and to change the direction of a standup of the liquid crystal molecule in each pixel, The approach (the IPS method) of applying horizontal electric field to liquid crystal, the method (VA liquid crystal method) of driving the liquid crystal which carried out perpendicular orientation, or the approach (the OCB method) of combining a bend orientation cel and an optical compensating plate is proposed, and a prototype is developed and built.

[0004] However, the orientation film of a certain thing, an electrode, liquid crystal orientation, etc. had to be changed, the manufacturing-technology establishment for it and establishment of a manufacturing facility were needed, and the effectiveness that these approaches are fixed has caused the difficulty and cost quantity of manufacture as a result.

[0005] On the other hand, no structure of TN-LCD is changed but there is an approach to which an angle of visibility is made to expand by building an optical compensation film into conventional TN-LCD. Since this approach has the advantage which amelioration and extension of a TN-LCD manufacturing facility are excellent in unnecessarily and in cost, and can be used simple, it attracts attention, and it has many proposals.

[0006] The cause which an angle-of-visibility problem generates in TN-LCD in the Nor Marie White (NW) mode is in the orientation condition of the liquid crystal in the cel at the time of the black display which carried out the seal of approval of the electrical potential difference. In this case, perpendicular orientation of the liquid crystal is carried out mostly, and it serves as optically uniaxial [forward] optically. Therefore, in order to compensate optically uniaxial [at the time of the black display of a liquid crystal cell / forward] as an optical compensation film for extending an angle of visibility, the proposal

using the film in which optically uniaxial [negative] is shown optically is made. Moreover, when the liquid crystal in a cel compensates using the negative optically uniaxial film with which the optical axis inclined paying attention to carrying out a cel interface, parallel, or leaning orientation near an orientation film interface at the time of a black display, the approach of heightening the angle-of-visibility expansion effectiveness further is also proposed.

[0007] For example, LCD using the optical compensation film and it using the cholesteric film with which the screw axis inclined is proposed by JP,4-349424,A and the No. 250166 [six to] official report. However, the approach for it being difficult to manufacture the cholesteric film with which the screw axis inclined, and leaning a screw axis during these patents also in fact is not indicated at all. Moreover, LCD using the negative 1 shaft compensator with which the optical axis inclined is proposed by JP,5-249547,A and the No. 331979 [six to] official report, and the multilayered film compensator is used as a concrete embodiment. LCD using the optical compensation film and it to which the optical axis furthermore inclined in JP,7-146409,A, a No. 5837 [eight to] official report, etc. and to which inclination orientation of the disco tic liquid crystal was carried out as a negative optically uniaxial compensation film is proposed. However, disco tic liquid crystal has the complicated chemical structure, and its composition is complicated. Moreover, since it is low-molecular liquid crystal, when film-izing, complicated processes, such as optical bridge formation, are needed and difficulty serves as cost quantity as a result with industrial manufacture.

[0008] The oriented film using the liquid crystallinity macromolecule which has optically uniaxial [forward] as other gestalten of a compensation film is also proposed. For example, the compensating plate for LCD which consists of a liquid crystallinity high polymer film which could twist in JP,7-140326,A and carried out tilt orientation is proposed, and it is used for angle-of-visibility expansion of LCD. However, it is not industrially easy to be able to twist in addition to tilt orientation and to introduce orientation into coincidence. Moreover, LCD using the viewing-angle compensating plate and it which consist of a film which carried out orientation of the nematic liquid crystallinity macromolecule to JP,7-198942,A and a No. 181324 [seven to] official report as a similar technique so that an optical axis might intersect a plate surface is proposed. However, since the compensating plate which made the optical axis incline simply also in this case is used, it cannot be said that the angle-of-visibility expansion effectiveness is enough.

[0009]

[Problem(s) to be Solved by the Invention] This invention offers the Twisted Nematic mold liquid crystal display with which the high contrast which is not in the former, and wide-field-of-view cornification were attained by solving these above-mentioned technical problem and combining the specific Twisted Nematic mold liquid crystal cell for a drive, and a nematic hybrid orientation compensation film.

[0010]

[Means for Solving the Problem] Namely, this invention is substantially formed from the liquid crystallinity macromolecule in which optically uniaxial [forward] is shown optically. The compensation film of at least one sheet which fixed the nematic hybrid orientation which the liquid crystallinity giant molecule concerned formed in the liquid crystal condition, It consists of two polarizing plates with which the TSUISUTEDDO nematic mold liquid crystal cell for a drive which consists of nematic liquid crystals pinched between the transparency substrate of the pair equipped with the electrode and the substrate concerned, and the liquid crystal cell concerned are arranged up and down at least. And it is the TSUISUTEDDO nematic mold liquid crystal display characterized by a product (deltand) with the thickness (d) of the liquid crystal layer in the refractive-index anisotropy (deltan) and the liquid crystal cell concerned of the nematic liquid crystal which constitutes said liquid crystal cell being 200nm - 500nm or less.

[0011]

[Embodiment of the Invention] Hereafter, it explains in more detail about this invention. If the TSUISUTEDDO nematic mold liquid crystal cell for a drive (it abbreviates to TN liquid crystal cell hereafter) used for this invention is classified according to a drive method, it is subdivisible like the active matrix using a TFT (Thin Film Transistor) electrode and an MIM (Metal Insulator Metal and TFD;Thin Film Diode) electrode using a passive matrix and an active element as an electrode. In this invention, remarkable effectiveness can be demonstrated to TN liquid crystal cell of which drive method.

[0012] deltand value shown by the product of the refractive-index anisotropy (deltan) of the liquid crystal cell concerned and the thickness (d) of the liquid crystal layer of the liquid crystal cell concerned is usually desirable 200nm - 500nm or less, and the range of 250nm - 470nm or less of 300nm - 450nm or less of TN liquid crystal cells used for this invention is 300nm - 400nm most preferably especially preferably. When larger than 500nm, there is a possibility that the angle-of-visibility improvement effect

at the time of combining with the compensation film explaining the back may become scarce, and a speed of response may become slow. Moreover, when smaller [than 200nm] and it combines with the compensation film concerned, the improvement effect of an angle of visibility has a possibility of producing the brightness of the transverse plane of a certain thing, and the fall of contrast.

[0013] Moreover, in order to reduce the orientation defect of the liquid crystal molecule of a nematic liquid crystal, as for TN liquid crystal cell, it is desirable to give a pre tilt angle beforehand to the liquid crystal molecule concerned. A pre tilt angle is usually 5 degrees or less.

[0014] Moreover, generally the major axis of the nematic liquid crystal in the liquid crystal cell concerned has twisted about 90 degrees of TN liquid crystal cells between vertical substrates. In the condition of not carrying out the seal of approval of the electrical potential difference, 90 degrees of linearly polarized lights which carried out incidence can be twisted to a liquid crystal cell by the optical activity, and they carry out outgoing radiation to it. If the seal of approval of the electrical potential difference is carried out to a liquid crystal cell, orientation of the major axis of a liquid crystal molecule will be carried out in the direction of electric field, and optical activity will disappear. Therefore, in order to fully acquire the effectiveness of this rotatory polarization, it is usually preferably desirable [the twist angle of TN liquid crystal cell used for this invention] that it is 85 degrees - 95 degrees 70 degrees - 110 degrees. In addition, either the left or the right is OK as the direction of torsion of the liquid crystal molecule in the liquid crystal cell concerned.

[0015] Subsequently, the compensation film used for this invention is explained. the liquid crystallinity macromolecule which the film concerned shows optically uniaxial [forward] optically -- concrete -- ** -- the liquid crystallinity high molecular compound in which optically uniaxial [forward] is shown optically, or ** -- the liquid crystallinity macromolecule constituent containing these at least one sort of liquid crystallinity high molecular compounds in which optically uniaxial [forward] is shown optically -- since -- it changes, and this liquid crystallinity high molecular compound or this liquid crystallinity macromolecule constituent fixes the nematic hybrid orientation formed in the liquid crystal condition, and is formed.

[0016] The compensation film concerned has turned to the include angle from which the director of eye backlash which is the film which fixed nematic hybrid orientation, and a liquid crystallinity macromolecule differs in all the locations of the direction of thickness of a film. Therefore, when the compensation film concerned is seen as the structure called a film, an optical axis does not exist any longer.

[0017] The compensation film which fixed such nematic hybrid orientation is not optically equivalent on the top face and inferior surface of tongue of this film. Therefore, when arranging to TN liquid crystal cell explained in the above, the angle-of-visibility expansion effectiveness differs somewhat by which field is arranged to this liquid crystal cell side. Although sufficient angle-of-visibility expansion effectiveness can be acquired in this invention whichever it arranges a field, it is desirable to arrange the field of the one where the include angle of the director of a liquid crystallinity macromolecule and a film flat surface to accomplish is small among the 2nd page of the upper and lower sides of a compensation film especially so that a liquid crystal cell may be approached most. The various parameters of the compensation film used for this invention here are explained.

[0018] The range of 0.2-10 micrometers of thickness of a compensation film is 0.1-20 micrometers usually 0.3-5 micrometers especially preferably first. When thickness is less than 0.1 micrometers, there is a possibility that sufficient compensation effect may not be acquired. Moreover, when thickness exceeds 20 micrometers, there is a possibility that the display of a display may color superfluously.

[0019] Subsequently, the retardation value of the appearance within the field at the time of seeing from [of a compensation film] a normal is explained. With the film which carried out nematic hybrid orientation, the refractive index (it calls Following ne) of a direction parallel to a director differs from the refractive index (it calls Following no) of a perpendicular direction. When the value which lengthened no from ne is seen and it considers as the upper rate of a birefringence, the retardation value on appearance is absolutely given by the product with thickness with the rate of a birefringence on appearance. The retardation value on this appearance can be easily calculated by polarization optical measurement, such as ellipsometry. the retardation value on the appearance of this compensation film -- the 550nm homogeneous light -- receiving -- usually -- 10-300nm 5-500nm is the range of 15-150nm especially preferably preferably. When an apparent retardation value is less than 5nm, there is a possibility that sufficient angle-of-visibility expansion effectiveness may not be acquired. Moreover, when than 500nm, and it sees from across, there is a possibility that coloring unnecessary for a display may arise.

[0020] Subsequently, the include angle of the director in the vertical interface of a compensation film is explained. The include angle of this director is usually 0 times [30 or less] or more preferably 0 times [50

or less] or more as an absolute value in the opposite side of nothing and the field concerned 60 degrees [90 or less] or more in either the top face of a film, or near the inferior-surface-of-tongue interface about 80-degree or more the include angle of 90 or less degrees as an absolute value.

[0021] Subsequently, the average tilt angle of a compensation film is explained. In this invention, the average value of the include angle of the director of a liquid crystallinity giant molecule and substrate flat surface in the direction of thickness to accomplish is defined as an average tilt angle. An average tilt angle can apply and search for the crystal rotation method. The range of the average tilt angle of the compensation film used for this invention is usually 20 - 50 degrees preferably 10 to 60 degrees. When it separates from the range of the above [an average tilt angle], there is a possibility that sufficient angle-of-visibility expansion effectiveness may not be acquired.

[0022] An above-mentioned liquid crystallinity giant molecule is formed substantially, and the compensation film used for this invention will not be limited, especially if it has the nematic hybrid orientation of this liquid crystallinity giant molecule and has the above-mentioned parameter.

[0023] It explains in more detail about the compensation film used for the liquid crystal display of this invention. The liquid crystallinity macromolecules which form this compensation film are specifically a homeotropic orientation nature liquid crystallinity macromolecule and a liquid crystallinity macromolecule constituent which more specifically contains a homeotropic orientation nature liquid crystallinity high molecular compound or the liquid crystallinity high molecular compound of at least one sort of homeotropic orientation nature.

[0024] A homeotropic orientation means the condition that the director of liquid crystal carried out orientation to the abbreviation perpendicular to the substrate flat surface here. This homeotropic orientation nature liquid crystallinity giant molecule is an indispensable component for realizing nematic hybrid orientation which the compensation film used for this invention forms.

[0025] The judgment of whether a liquid crystallinity macromolecule is homeotropic orientation nature forms a liquid crystallinity macromolecule layer on a substrate, and is performed by judging the orientation condition. Although there is especially no limitation as a substrate which can be used for this judgment, for example on a glass substrate and a twist concrete target Optical glass, such as soda glass, potash glass, boro-silicated glass, crown glass, and flint glass, etc., The plastic film or the sheet which has thermal resistance in the liquid crystal temperature of a liquid crystallinity giant molecule, More specifically Polyethylene terephthalate, polyethylenenaphthalate, Polyphenylene oxide, polyimide, polyamidoimide, polyether imide, a polyamide, a polyether ketone, a polyether ether ketone, poly ketone sulfide, polyether sulfone, etc. can be used as a substrate. In addition, although the substrate illustrated above is used after it makes a front face clarification with an acid, alcohols, a detergent, etc., surface treatment, such as siliconizing, is used, without carrying out.

[0026] That in which the homeotropic orientation nature liquid crystallinity macromolecule used for this invention forms the film of a liquid crystallinity macromolecule on the substrate illustrated above, and these some liquid crystallinity macromolecules form a homeotropic orientation on one sort of substrates among these substrates in the temperature which shows a liquid crystal condition is defined as a homeotropic orientation nature liquid crystallinity macromolecule. However, there are some which carry out a homeotropic orientation specifically at the temperature near the liquid crystal-isotropic phase transition point with the class of liquid crystallinity macromolecule, a presentation, etc. Therefore, it is usually more desirable than the liquid crystal-isotropic phase transition point to carry out at the temperature of 20 degrees C or less preferably 15 degrees C or less.

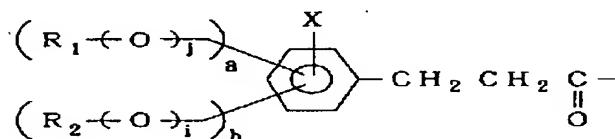
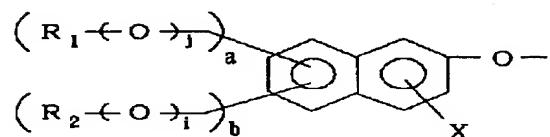
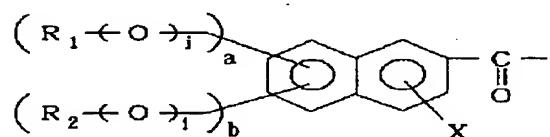
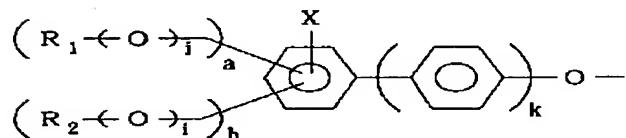
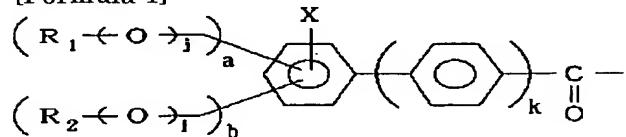
[0027] As this homeotropic orientation nature liquid crystallinity macromolecule for example, the inside of the structural unit which constitutes the principal chain of a ** liquid crystallinity macromolecule -- ** -- the aromatic series radical which has a high substituent -- The liquid crystallinity macromolecule which has the aromatic series radical which has a long-chain alkyl group, the aromatic series radical which has a fluorine atom, ** In the end or both ends of a liquid crystallinity macromolecule chain, it has the long-chain alkyl group of carbon numbers 3-20, or the long-chain fluoro alkyl group of carbon numbers 2-20. The liquid crystallinity macromolecule which has the structural unit of one functionality guided from the compound which has one functionality parts, such as monoalcohol and monocarboxylic acid, is mentioned.

[0028] The thing of the structure which the monomer with one functional group equivalent to the functional group which the bifunctional monomer used in case the condensation polymer whose structural unit of one functionality used for the liquid crystallinity macromolecule of the above-mentioned ** is a liquid crystallinity macromolecule is formed has was made to live together at the time of manufacture of this polymer (under a polymerization reaction or after a polymerization reaction), and was incorporated into this polymer molecule is said, and it is usually included in the piece end or the both

ends of this polymer molecule. Therefore, the number of the structural units of this one functionality that exists in this polymer molecule is usually 1·2 per molecule. It is as follows when the structural unit of this one functionality is expressed with a general formula.

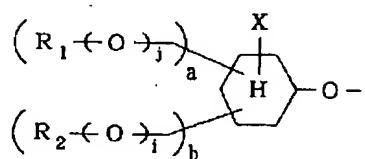
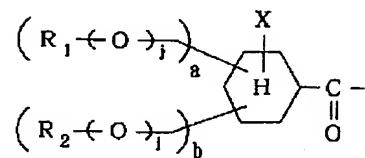
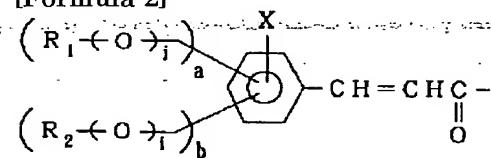
[0029]

[Formula 1]



[0030]

[Formula 2]



[0031] the above-mentioned general formula .. setting .. R1 And R2 the same .. or you may differ. R1 and

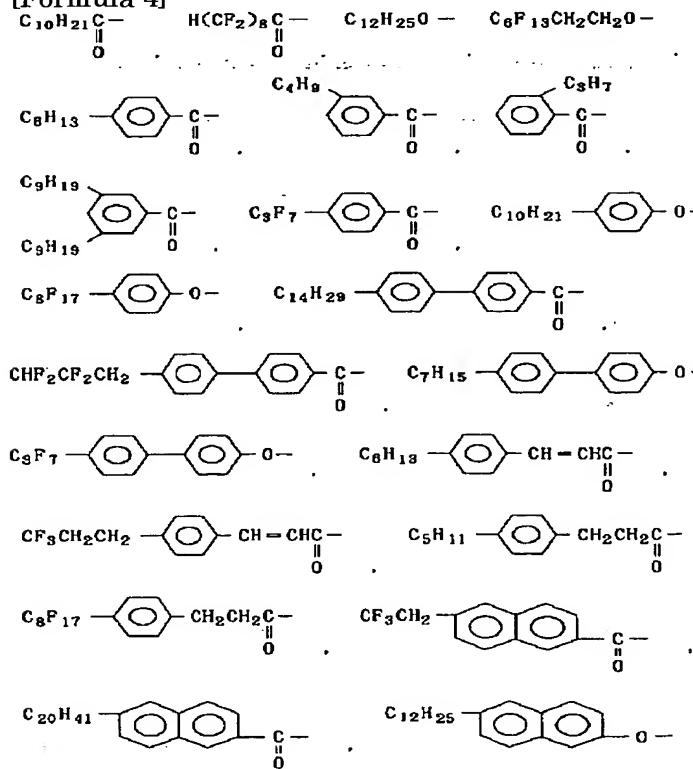
R2 The long-chain alkyl group of carbon numbers 3-20 or the long-chain fluoro alkyl group of carbon numbers 2-20 is expressed. Specifically, it is [0032].

[Formula 3]

$\text{CH}_3\text{CH}_2\text{CH}_2 - , \text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2 - ,$
 $\text{C}(\text{CH}_3)_3 - , (\text{CH}_3)_2\text{CH} - , \text{CH}_3(\text{CH}_2)_3 - , \text{C}_5\text{H}_{11} - ,$
 $\text{C}_9\text{H}_{19} - , \text{C}_6\text{H}_{13} - , \text{C}_8\text{H}_{17} - , \text{C}_7\text{H}_{15} - , \text{C}_{10}\text{H}_{21} - ,$
 $\text{C}_{12}\text{H}_{25} - , \text{C}_{14}\text{H}_{29} - , \text{C}_{18}\text{H}_{37} - , \text{C}_{16}\text{H}_{33} - , \text{C}_{20}\text{H}_{41} - ,$
 $\text{CF}_3\text{CH}_2 - , \text{CF}_3\text{CF}_2 - , (\text{CF}_3)_2\text{CF} - ,$
 $(\text{CF}_3)_2\text{CF}(\text{CF}_2)_2 - , \text{C}_6\text{F}_{13} - , \text{C}_8\text{F}_{17} - ,$
 $\text{CF}_3(\text{CF}_2)_3\text{CH}_2\text{CH}_2 - , (\text{CF}_3)_2\text{CF}(\text{CF}_2)_8 - ,$
 $\text{CHF}_2\text{CF}_2\text{CH}_2 - , \text{CF}_3\text{CH}_2\text{CH}_2 - ,$
 $(\text{CF}_3)_2\text{CF}(\text{CF}_2)_8\text{CH}_2\text{CH}_2 - ,$
 $\text{CF}_3(\text{CF}_2)_7\text{CH}_2\text{CH}_2 - , \text{H}(\text{CF}_2)_4\text{CH}_2 - ,$
 $\text{CF}_3(\text{CF}_2)_9\text{CH}_2\text{CH}_2 - , \text{CF}_3(\text{CF}_2)_3(\text{CH}_2)_6 - ,$
 $\text{CF}_3\text{CF}_2(\text{CH}_2)_6 - , \text{CHF}_2\text{CF}_2\text{CH}_2 - ,$
 $\text{CF}_3(\text{CF}_2)_5\text{CH}_2\text{CH}_2 - , \text{H}(\text{CF}_2)_6\text{CH}_2 - ,$
 $\text{H}(\text{CF}_2)_4\text{CH}_2 - , \text{H}(\text{CF}_2)_8\text{CH}_2 - ,$

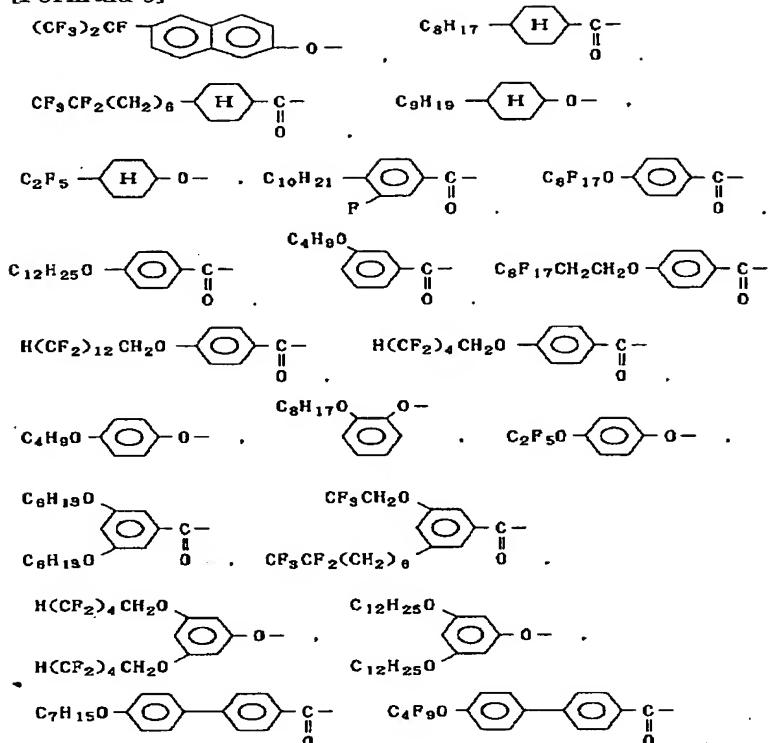
[0033] **** can be illustrated as a desirable thing. Moreover, X is halogens, such as hydrogen, a fluorine, and chlorine, etc. Moreover, i is 0 or 1. Moreover, j is 0 or 1. Moreover, k is 0 or 1. Furthermore, 0 or 1b of a is 0 or 1. However, it is $a+b!=0$. It is [0034] as a structural unit of one functionality formed from monoalcohol, above-mentioned monocarboxylic acid, and these above-mentioned functional derivatives.

[Formula 4]



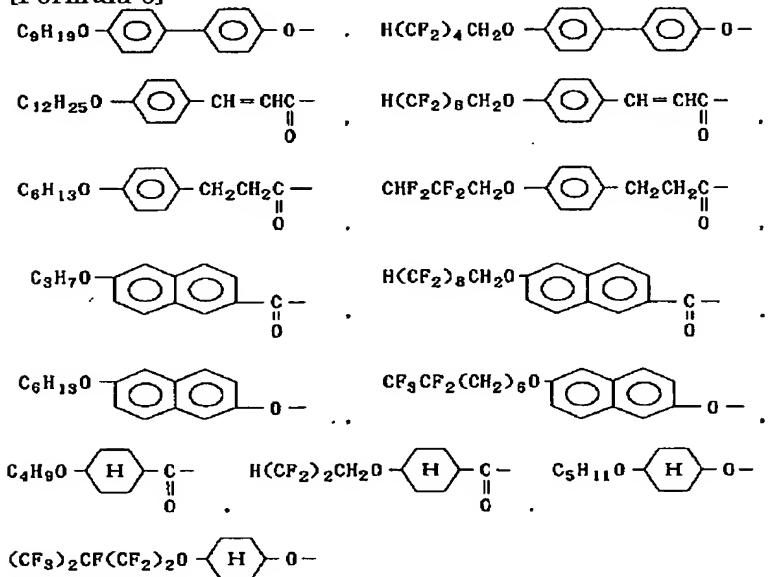
[0035]

[Formula 5]



[0036]

[Formula 6]



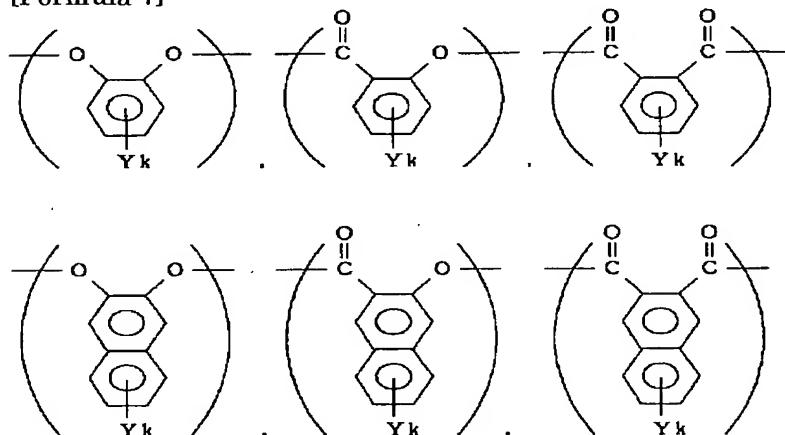
[0037] **** can be illustrated as a desirable unit. One sort chosen from the structural unit of one functionality illustrated above or two sorts constitute the piece end or both ends of a macromolecule chain. In addition, in case it has this structural unit in both ends, the unit of both ends does not need to be the same.

[0038] As a concrete liquid crystallinity macromolecule, principal chain mold liquid crystallinity macromolecules, such as polyester which fulfills the conditions of ** and/or **, polyimide, a polyamide, a polycarbonate, and polyester imide, are mentioned. A composite ease, the ease of film-izing, the stability of the physical properties of the obtained film, etc. to liquid crystallinity polyester is desirable especially also in these. Generally the principal chain of liquid crystallinity polyester is formed from polyfunctional structural units other than bifunctional structural units and these units, such as a dicarboxylic acid unit, a diol unit, and a hydroxy acid unit. As liquid crystallinity polyester which forms the compensation film

used for this invention, what has an orthochromatic permutation aromatic series unit in a principal chain is more desirable. What has a substituent can be mentioned to catechol unit [as specifically shown below], salicylic-acid unit, phthalic-acid unit, 2, 3-naphthalene diol unit, 2, and 3-naphthalene dicarboxylic acid units, and these benzene rings.

[0039]

[Formula 7]

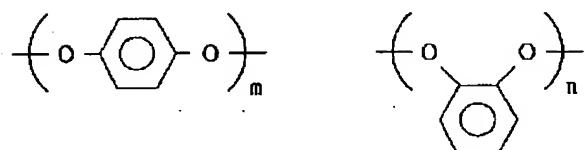


[0040] (Y shows halogens, such as Cl and Br, a methyl group, an ethyl group, a methoxy group, an ethoxy radical, or a phenyl group.) Moreover, k is 0·2.

The concrete example of structure of the liquid crystallinity polyester of homeotropic orientation nature which fulfills the conditions of the above-mentioned ** and ** is shown below. ** As what fulfills conditions, it is [0041].

[Formula 8]

構造式 1

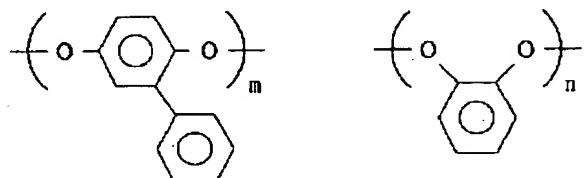
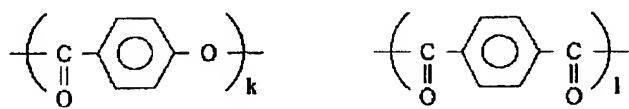


[0042] l=m+n, and k/l=20 / 10 · 0/10 .. desirable .. 15/10-0/10 n/m=100 / 0 · 20/80 .. desirable .. 98/2-30/70k, and l, m and n .. respectively .. a mol .. a presentation ratio is shown.

[0043]

[Formula 9]

構造式 2



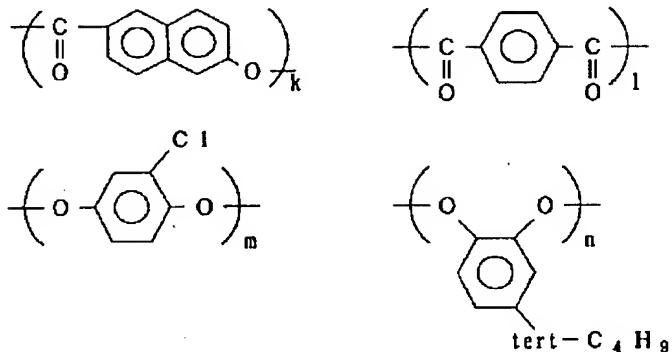
[0044] l=m+n, and k/l=20 / 10 · 0/10 .. desirable .. 15/10-0/10 m/n=100 / 0 · 1/99 .. desirable .. 90/10-2/98k,

and l, m and n -- respectively -- a mol -- a presentation ratio is shown.

[0045]

[Formula 10]

構造式 3

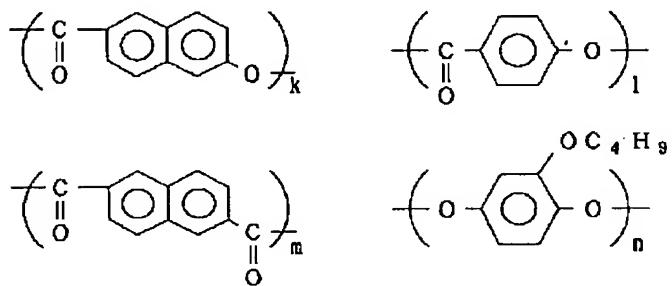


[0046] l=m+n, and k/l=20 / 10 · 0/10 -- desirable -- 15/10·0/10 n/m=100 / 0 · 1/99 -- desirable -- 90/10·2/98k, and l, m and n -- respectively -- a mol -- a presentation ratio is shown.

[0047]

[Formula 11]

構造式 4

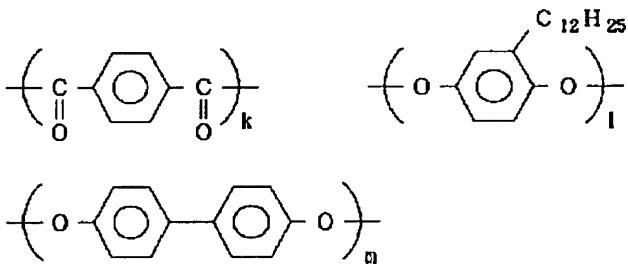


[0048] m=n, (k+l) / m= 20 / 10 · 2/10 -- desirable -- 15/10·5/10 k/l=100 / 0 · 0/100 -- desirable -- 95/5·5/95k, and l, m and n -- respectively -- a mol -- a presentation ratio is shown.

[0049]

[Formula 12]

構造式 5

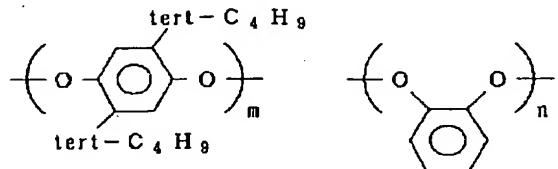
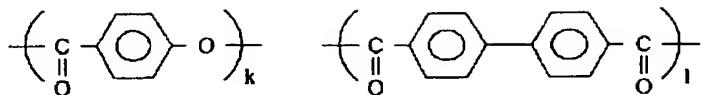


[0050] k=m+n, and l/m=100 / 0 · 1/99 -- desirable -- 90/10·2/98k, and l and m -- respectively -- a mol -- a presentation ratio is shown.

[0051]

[Formula 13]

構造式 6

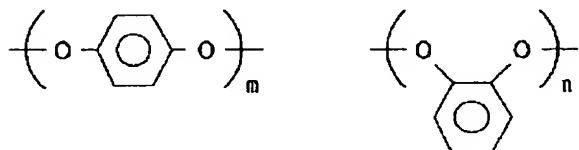
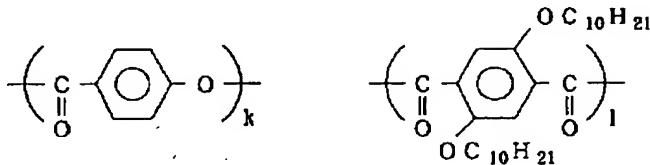


[0052] $l=m+n$, and $k/l=20 / 10 \cdot 0/10 \cdots$ desirable $\cdots 15/10 \cdot 0/10$ $m/n=100 / 0 \cdot 1/99 \cdots$ desirable $\cdots 90/10 \cdot 2/98k$, and l , m and n \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0053]

[Formula 14]

構造式 7

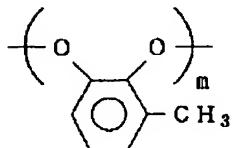
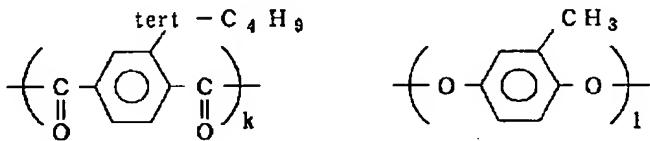


[0054] $l=m+n$, and $k/l=20 / 10 \cdot 0/10 \cdots$ desirable $\cdots 15/10 \cdot 0/10$ $m/n=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95k$, and l , m and n \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0055]

[Formula 15]

構造式 8

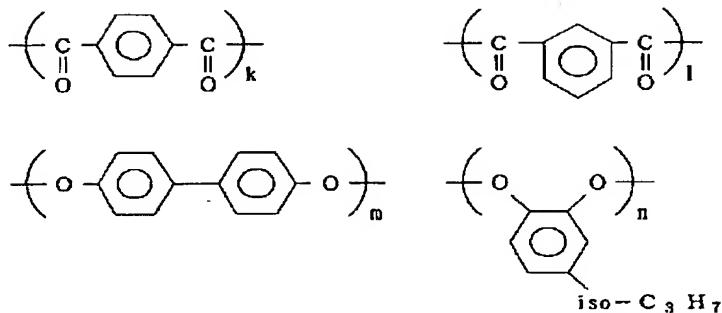


[0056] $k=l+m$, and $l/m=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95k$, and l , m and n \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0057]

[Formula 16]

構造式 9

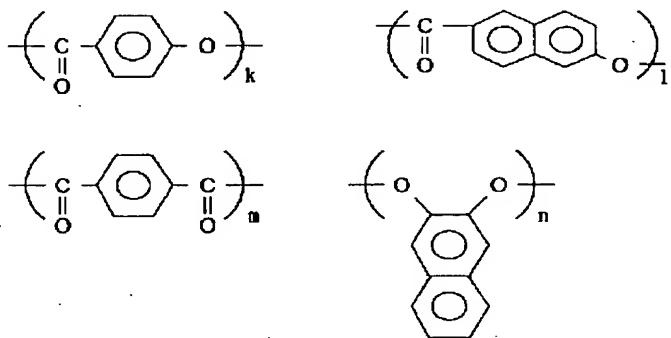


[0058] $k+l=m+n$, and $k/l=100 / 0 \cdot 0/100$ -- desirable -- 95/5-5/95 $n/m=100 / 0 \cdot 1/99$ -- desirable -- 90/10-2/98k, and l, m and n -- respectively -- a mol -- a presentation ratio is shown.

[0059]

[Formula 17]

構造式 10

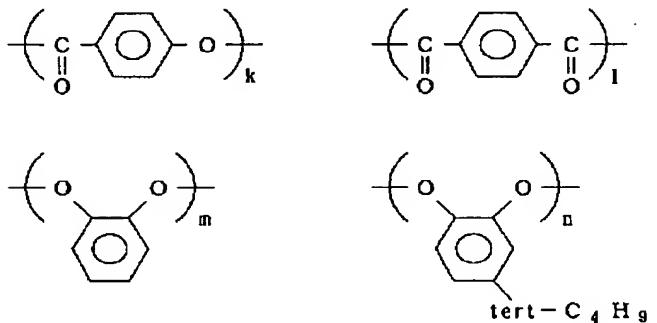


[0060] $m=n$, $(k+l) / m = 20 / 10 \cdot 2/10$ -- desirable -- 5/10-5/10k, and l, m and n -- respectively -- a mol -- a presentation ratio is shown.

[0061]

[Formula 18]

構造式 11

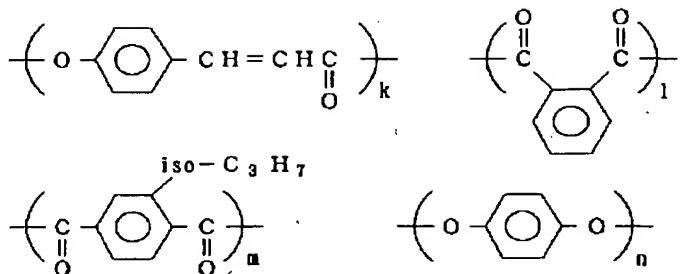


[0062] $l=m+n$, and $k/l=20 / 10 \cdot 0/10$ -- desirable -- 15/10-0/10 $n/m=100 / 0 \cdot 1/99$ -- desirable -- 90/10-2/98k, and l, m and n -- respectively -- a mol -- a presentation ratio is shown.

[0063]

[Formula 19]

構造式 1 2

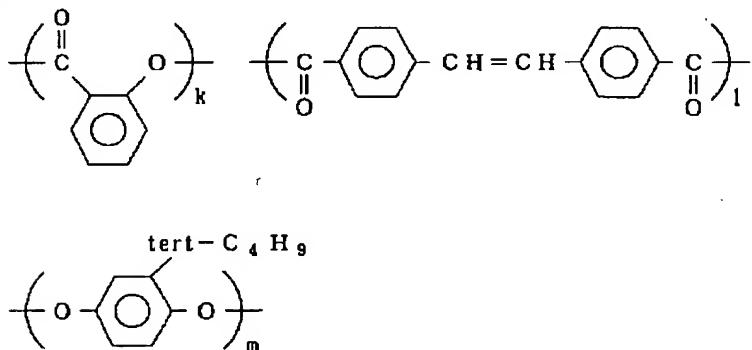


[0064] $n=m+l$, and $k/n=20 / 10 \cdot 0/10$.. desirable .. $15/10 \cdot 0/10$ $m/l=100 / 0 \cdot 1/99$.. desirable .. $90/10 \cdot 2/98k$, and l, m and n .. respectively .. a mol .. a presentation ratio is shown.

[0065]

[Formula 20]

構造式 1 3

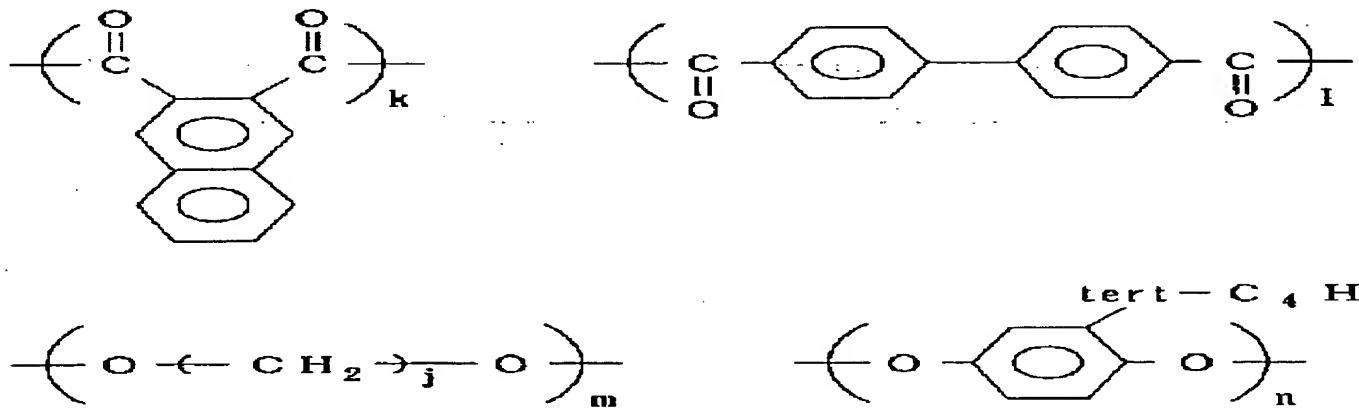


[0066] $l=m$, and $k/l=20 / 10 \cdot 0/10$.. desirable .. $15/10 \cdot 0/10k$, and l and m .. respectively .. a mol .. a presentation ratio is shown.

[0067]

[Formula 21]

構造式 1 4



[0068] $k+l=m+n$, and $k/l=100 / 0 \cdot 0/100$.. desirable .. $95/5 \cdot 5/95$ $m/n=100 / 0 \cdot 0/100$.. desirable .. $95/5 \cdot 5/95k$, and l, m and n .. respectively .. a mol .. a presentation ratio is shown. j shows the integer of 2-12.

[0069]

[Formula 22]

<IMG

SRC="getimg.ipdl?N0000=15&N0001=web308&N0002=006&N0003=JPA411194371_000024.gif&N0004=20050802085616988034.stamp" WIDTH="392" HEIGHT="253" ALT="ID=000024">

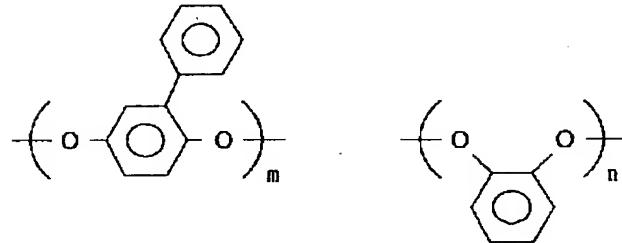
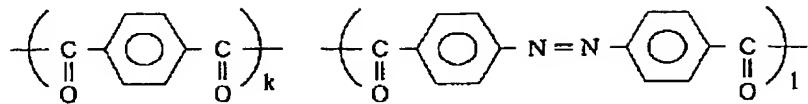
[0070] $k+l=m+n$, and $k/l=100 / 0 \cdot 0/100$.. desirable .. $95/5 \cdot 5/95$ $m/n=100 / 0 \cdot 0/100$.. desirable ..

95/5-5/95k, and l, m and n -- respectively -- a mol -- a presentation ratio is shown. j shows the integer of 2-12.

[0071]

[Formula 23]

構造式 1 6

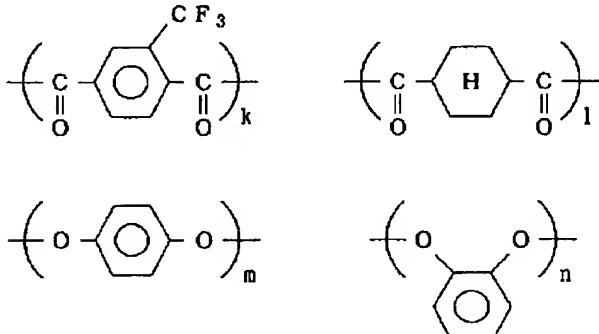


[0072] k+l=m+n, and k/l=100 / 0 - 0/100 -- desirable -- 95/5-5/95 m/n=100 / 0 - 1/99 -- desirable -- 90/10-2/98k, and l, m and n -- respectively -- a mol -- a presentation ratio is shown.

[0073]

[Formula 24]

構造式 1 7

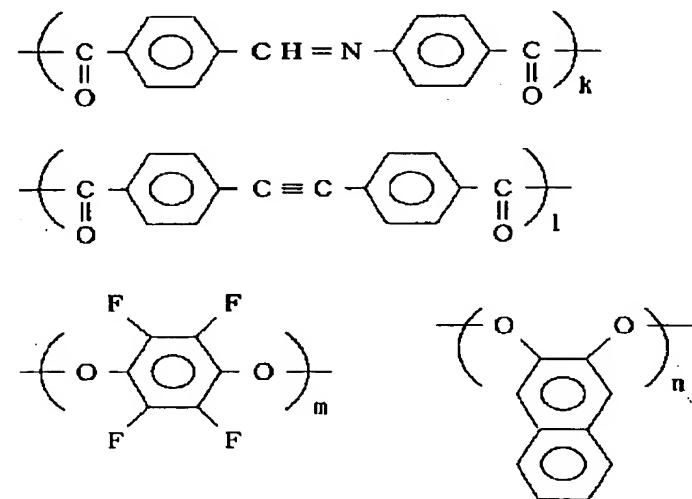


[0074] k+l=m+n, and k/l=100 / 0 - 1/99 -- desirable -- 90/10-2/98. m/n=100 / 0 - 0/100 -- desirable -- 95/5-5/95k, and l, m and n -- respectively -- a mol -- a presentation ratio is shown.

[0075]

[Formula 25]

構造式 1 8

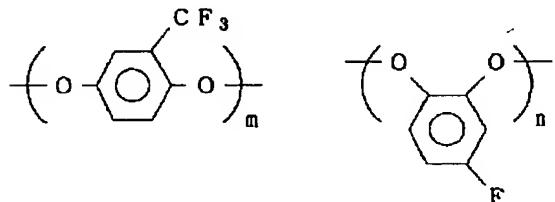


[0076] $k+l=m+n$, and $k/l=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95$ m/n=100 / 0 · 1/99 · desirable $\cdots 90/10 \cdot 2/98k$, and l, m and n · respectively · a mol · a presentation ratio is shown.

[0077]

[Formula 26]

構造式 1 9

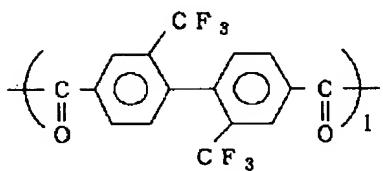
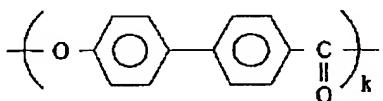


[0078] $l=m+n$, and $k/l=20 / 10 \cdot 0/10 \cdots$ desirable $\cdots 15/10 \cdot 0/10$ m/n=100 / 0 · 0/100 · desirable $\cdots 95/5 \cdot 5/95k$, and l, m and n · respectively · a mol · a presentation ratio is shown.

[0079]

[Formula 27]

構造式 2 0

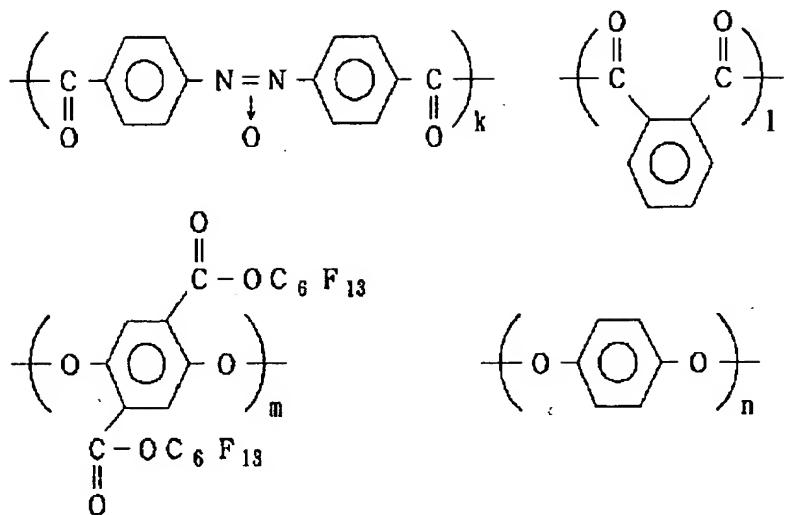


[0080] $l=m+n$, and $k/l=20 / 10 \cdot 0/10 \cdots$ desirable $\cdots 15/10 \cdot 0/10$ m/n=100 / 0 · 0/100 · desirable $\cdots 95/5 \cdot 5/95k$, and l, m and n · respectively · a mol · a presentation ratio is shown. j shows the integer of 2-12.

[0081]

[Formula 28]

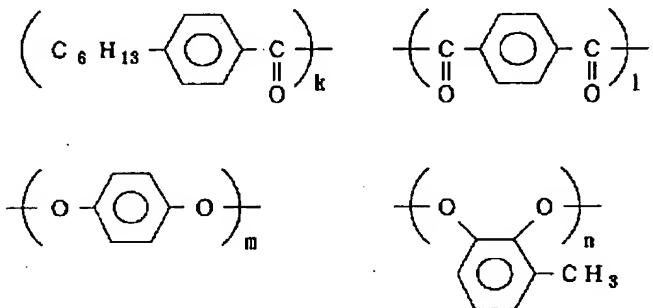
構造式 2 1



[0082] $k+l=m+n$, and $k/l=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95$ $m/n=100 / 0 \cdot 1/99 \cdots$ desirable $\cdots 90/10 \cdot 2/98k$, and l , m and n \cdots respectively \cdots a mol \cdots a presentation ratio is shown. **** is mentioned. Moreover, as what fulfills the conditions of **, it is [0083].

[Formula 29]

構造式 2 2

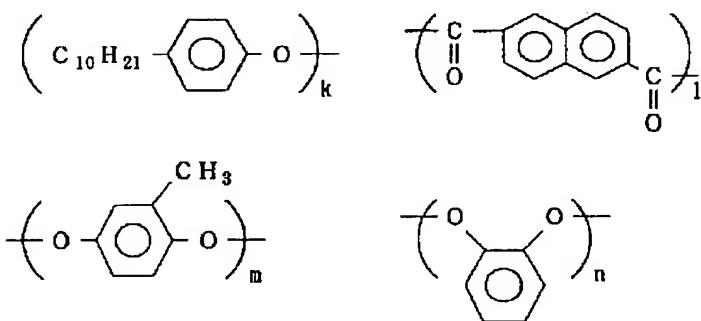


[0084] $m+n=k+lk/l=80 / 60 \cdot 2/99 \cdots$ desirable $\cdots 40/80 \cdot 10/95$ $m/n=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95k$, and l , m and n \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0085]

[Formula 30]

構造式 2 3

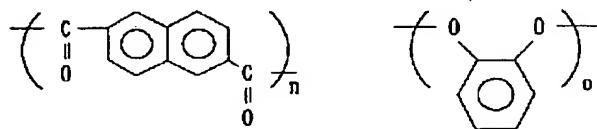
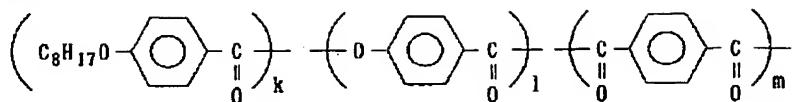


[0086] $l=k/2+m+nk/(m+n)=80 / 60 \cdot 2/99 \cdots$ desirable $\cdots 40/80 \cdot 10/95$ $m/n=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95k$, and l , m and n \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0087]

[Formula 31]

構造式 2 4

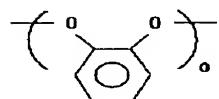
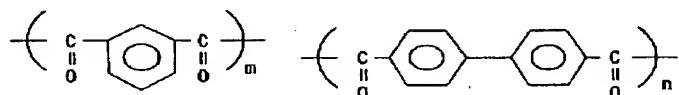
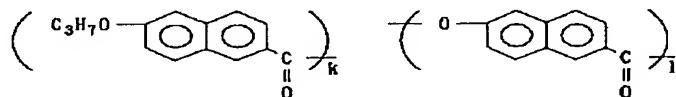


[0088] $\text{o} = k/2 + m + nk/(m+n) = 80 / 60 - 2/99$ -- desirable -- $40/80 \cdot 10/95$ $\text{m/n}=100 / 0 - 0/100$ -- desirable -- $95/5 \cdot 5/95$ $\text{l/o}=20 / 10 - 0/10$ -- desirable -- $15/10 \cdot 5/10k$, and l, m, n and o -- respectively -- a mol -- a presentation ratio is shown.

[0089]

[Formula 32]

構造式 2 5

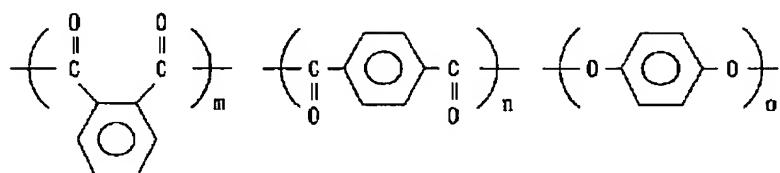
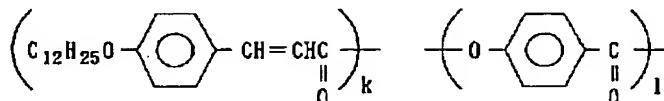


[0090] $\text{o} = k/2 + m + nk/(m+n) = 80 / 60 - 2/99$ -- desirable -- $40/80 \cdot 10/95$ $\text{m/n}=100 / 0 - 0/100$ -- desirable -- $95/5 \cdot 5/95$ $\text{l/o}=20 / 10 - 0/10$ -- desirable -- $15/10 \cdot 5/10k$, and l, m, n and o -- respectively -- a mol -- a presentation ratio is shown.

[0091]

[Formula 33]

構造式 2 6

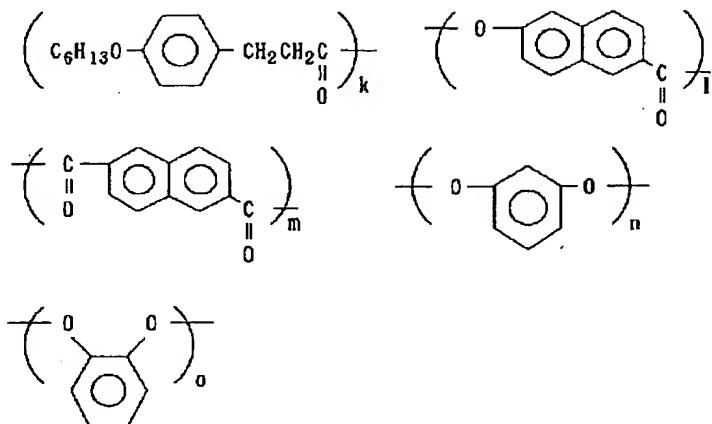


[0092] $\text{o} = k/2 + m + nk/(m+n) = 80 / 60 - 2/99$ -- desirable -- $40/80 \cdot 10/95$ $\text{m/n}=100 / 0 - 0/100$ -- desirable -- $95/5 \cdot 5/95$ $\text{l/o}=20 / 10 - 0/10$ -- desirable -- $15/10 \cdot 5/10k$, and l, m, n and o -- respectively -- a mol -- a presentation ratio is shown.

[0093]

[Formula 34]

構造式 2 7

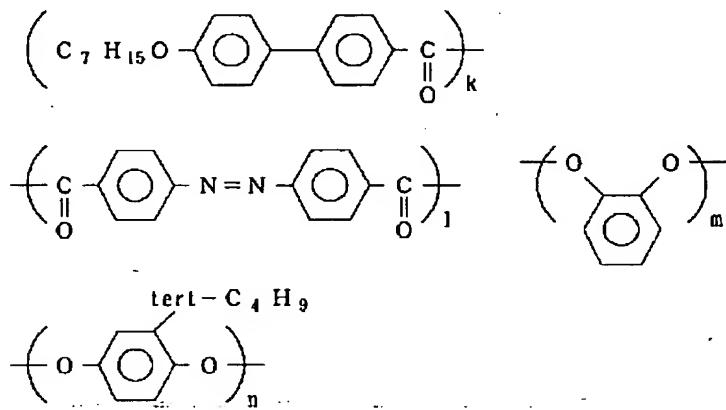


[0094] $n+o=k/2+mk/m=80 / 60 \cdot 2/99 \cdots \text{desirable} \cdots 40/80 \cdot 10/95 \quad n/o=100 / 0 \cdot 0/100 \cdots \text{desirable} \cdots 95/5 \cdot 5/95 l/(n+o)=20 / 10 \cdot 0/10 \cdots \text{desirable} \cdots 15/10 \cdot 5/10 k, \text{and } l, m, n \text{ and } o \cdots \text{respectively} \cdots \text{a mol} \cdots \text{a presentation ratio is shown.}$

[0095]

[Formula 35]

構造式 2 8

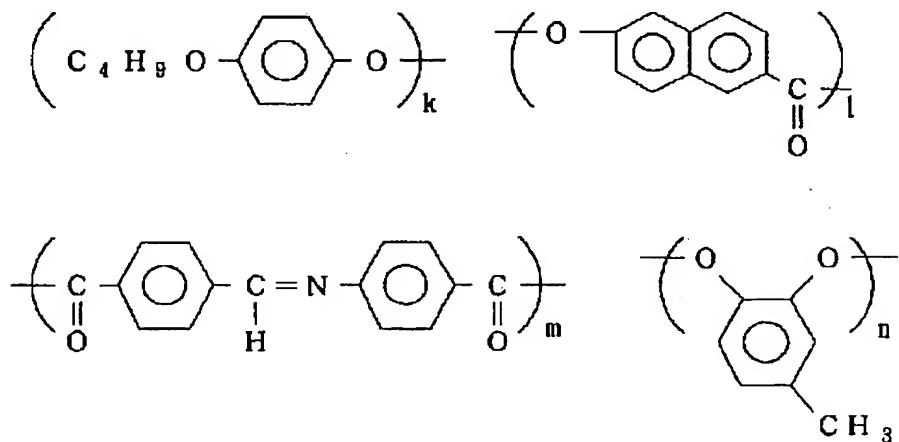


[0096] $m+n=k/2+lk/l=80 / 60 \cdot 2/99 \cdots \text{desirable} \cdots 40/80 \cdot 10/95 \quad m/n=100 / 0 \cdot 0/100 \cdots \text{desirable} \cdots 95/5 \cdot 5/95 k, \text{and } l, m \text{ and } n \cdots \text{respectively} \cdots \text{a mol} \cdots \text{a presentation ratio is shown.}$

[0097]

[Formula 36]

構造式 2 9



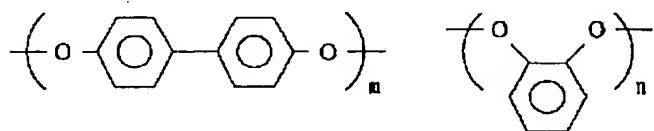
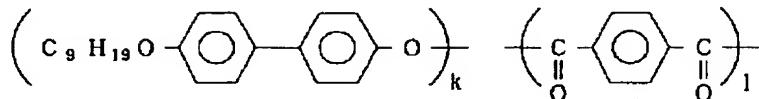
[0098] $m=k/2+nk/n=80 / 60 \cdot 2/99 \cdots \text{desirable} \cdots 40/80 \cdot 10/95 \quad l/m=20 / 10 \cdot 0/10 \cdots \text{desirable} \cdots 15/10 \cdot 5/10 k,$

and l, m and n -- respectively -- a mol -- a presentation ratio is shown.

[0099]

[Formula 37]

構造式 3-0

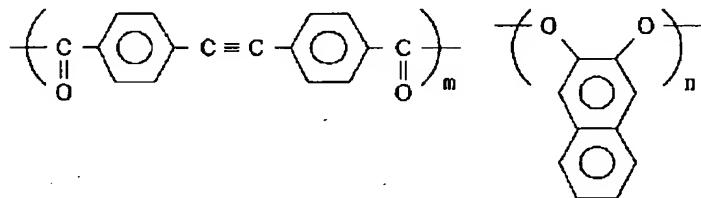
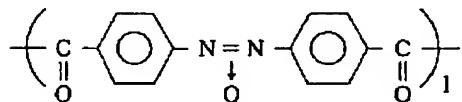
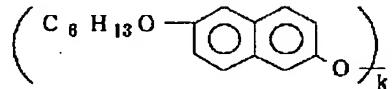


[0100] $l=k/2+m+nk/(m+n) = 80 / 60 - 2/99$ -- desirable -- $40/80-10/95$ $m/n=100 / 0 - 0/100$ -- desirable -- $95/5-5/95k$, and l, m and n -- respectively -- a mol -- a presentation ratio is shown.

[0101]

[Formula 38]

構造式 3-1

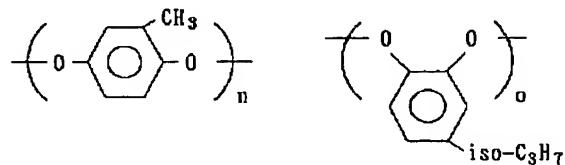
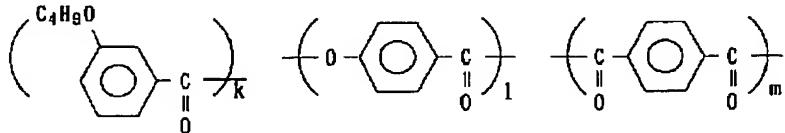


[0102] $l+m=k/2+nk/n=80 / 60 - 2/99$ -- desirable -- $40/80-10/95$ $l/m=100 / 0 - 0/100$ -- desirable -- $95/5-5/95k$, and l, m and n -- respectively -- a mol -- a presentation ratio is shown.

[0103]

[Formula 39]

構造式 3-2

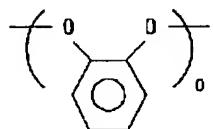
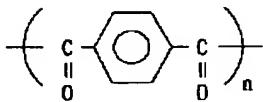
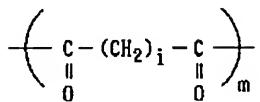
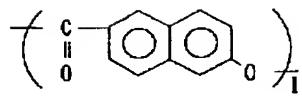
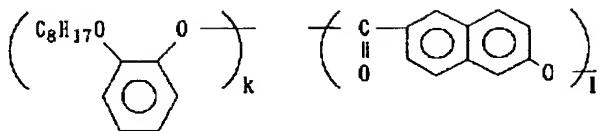


[0104] $n+o=k/2+mk/m=80 / 60 - 2/99$ -- desirable -- $40/80-10/95$ $n/o=100 / 0 - 0/100$ -- desirable -- $95/5-5/95l/(n+o)=20 / 10 - 0/10$ -- desirable -- $15/10-5/10k$, and l, m, n and o -- respectively -- a mol -- a presentation ratio is shown.

[0105]

[Formula 40]

構造式 3-3

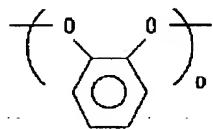
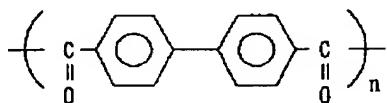
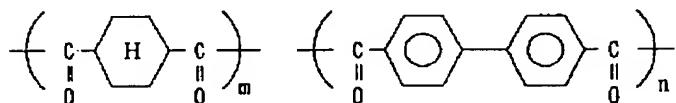
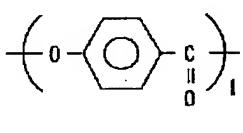
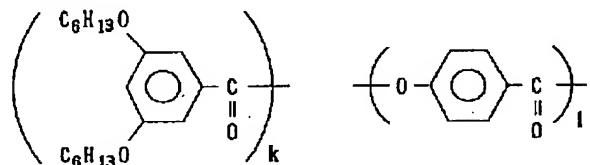


[0106] $m+n=k/2+ok/o=80 / 60 \cdot 2/99 \cdots$ desirable $\cdots 40/80 \cdot 10/95 \text{ m/n}=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95 l/(m+n)=20 / 10 \cdot 0/10 \cdots 15/10 \cdot 5/10 i$ shows the integer of 2-12 preferably. k, l, m, n , and o show a mol presentation ratio, respectively.

[0107]

[Formula 41]

構造式 3-4

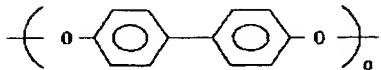
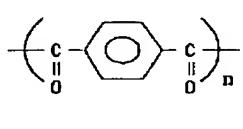
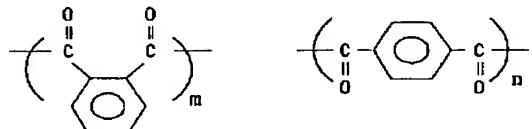
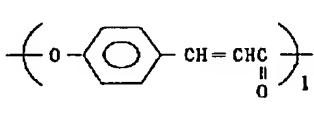
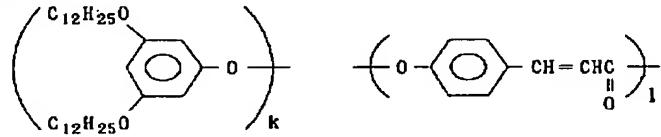


[0108] $o=k/2+m+nk/(m+n)=80 / 60 \cdot 2/99 \cdots$ desirable $\cdots 40/80 \cdot 10/95 \text{ m/n}=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95 l/o=20 / 10 \cdot 0/10 \cdots$ desirable $\cdots 15/10 \cdot 5/10 k, l, m, n$ and o \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0109]

[Formula 42]

構造式 3-5

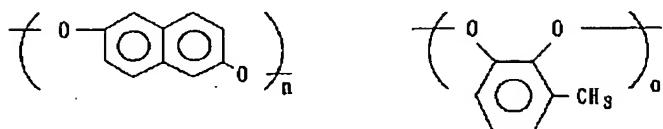
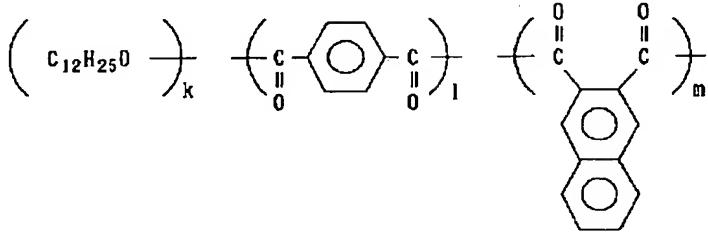


[0110] $m+n=k/2+ok/o=80 / 60 \cdot 2/99 \cdots$ desirable $\cdots 40/80 \cdot 10/95 m/n=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95 l/(m+n)=20 / 10 \cdot 0/10 \cdots$ desirable $\cdots 15/10 \cdot 5/10 k$, and l , m , n and o \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0111]

[Formula 43]

構造式 3 6

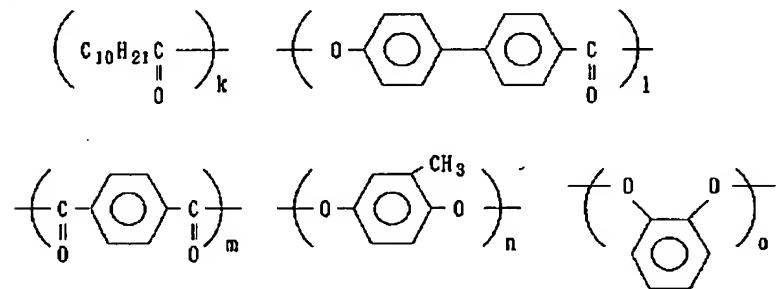


[0112] $l+m=k/2+n+ok/(n+o)=80 / 60 \cdot 2/99 \cdots$ desirable $\cdots 40/80 \cdot 10/95 l/m=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95 n/o=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95 k$, and l , m , n and o \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0113]

[Formula 44]

構造式 3 7

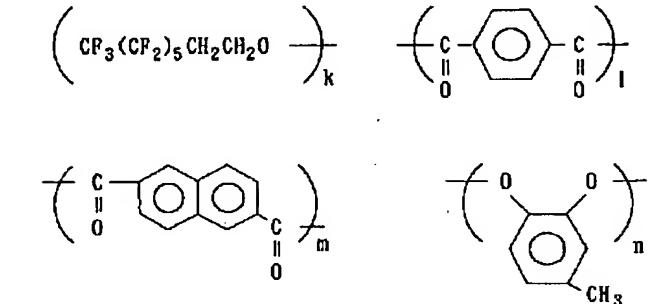


[0114] $n+o=k/2+mk/m=80 / 60 \cdot 2/99 \cdots$ desirable $\cdots 40/80 \cdot 10/95 n/o=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95 l/m=20 / 10 \cdot 0/10 \cdots$ desirable $\cdots 15/10 \cdot 5/10 k$, and l , m , n and o \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0115]

[Formula 45]

構造式 3 8

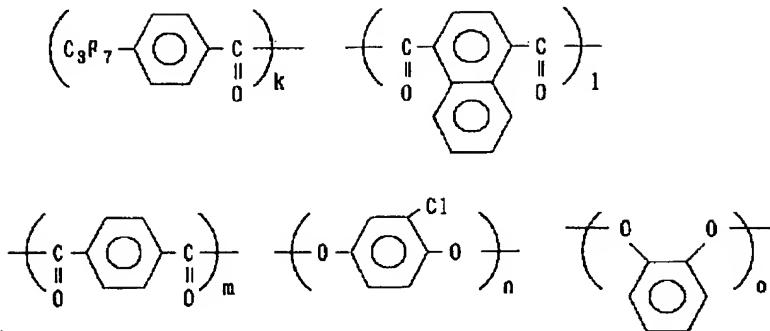


[0116] $l+m=k/2+ok/o=80 / 60 \cdot 2/99 \cdots$ desirable $\cdots 40/80 \cdot 10/95 l/m=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95 k$, and l , m and n \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0117]

[Formula 46]

構造式 3 9

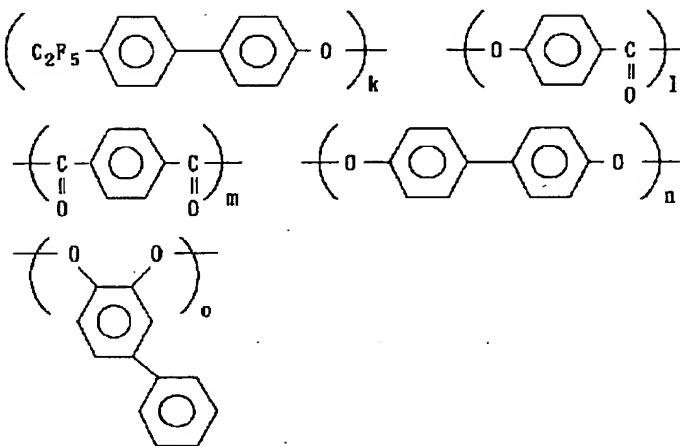


[0118] $n+o=k/2+l+mk/(l+m)=80 / 60 \cdot 2/99 \cdots$ desirable $\cdots 40/80 \cdot 10/95 l/m=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95 n/o=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95 k$, and l , m , n and o \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0119]

[Formula 47]

構造式 4 0

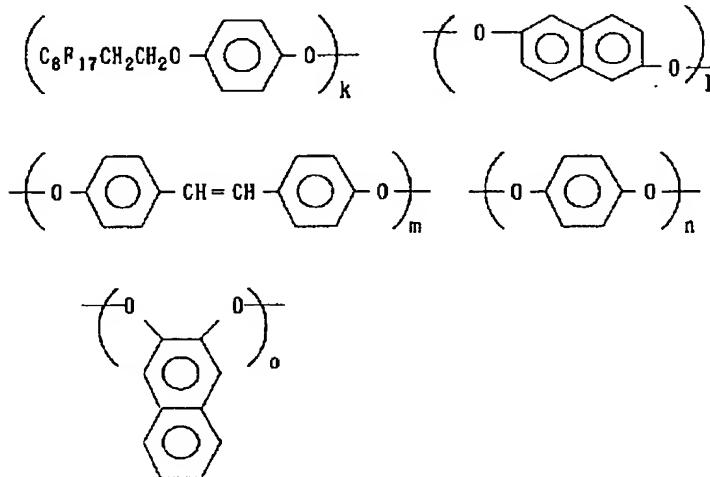


[0120] $m=k/2+n+ok/(n+o)=80 / 60 \cdot 2/99 \cdots$ desirable $\cdots 40/80 \cdot 10/95 n/o=100 / 0 \cdots 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95 l/m=20 / 10 \cdot 0/10 \cdots$ desirable $\cdots 15/10 \cdot 5/10 k$, and l , m , n and o \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0121]

[Formula 48]

構造式 4 1



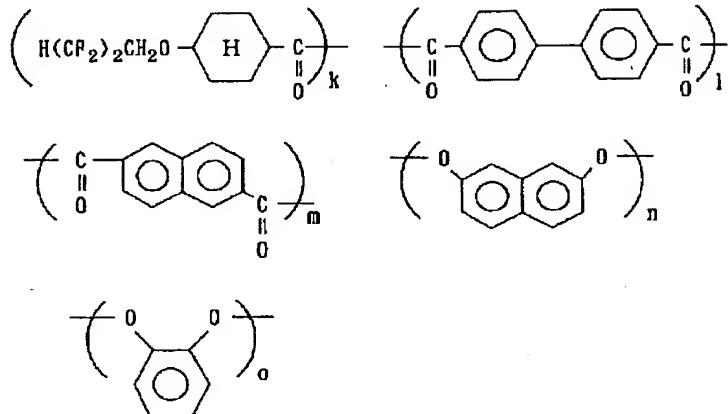
[0122] $o=k/2+m+nk/(m+n)=80 / 60 \cdot 2/99 \cdots$ desirable $\cdots 40/80 \cdot 10/95 m/n=100 / 0 \cdot 0/100 \cdots$ desirable \cdots

95/5-5/95 l/m=20 / 10 - 0/10 -- desirable -- 15/10-5/10k, and l, m, n and o -- respectively -- a mol -- a presentation ratio is shown.

[0123]

[Formula 49]

構造式 4-2

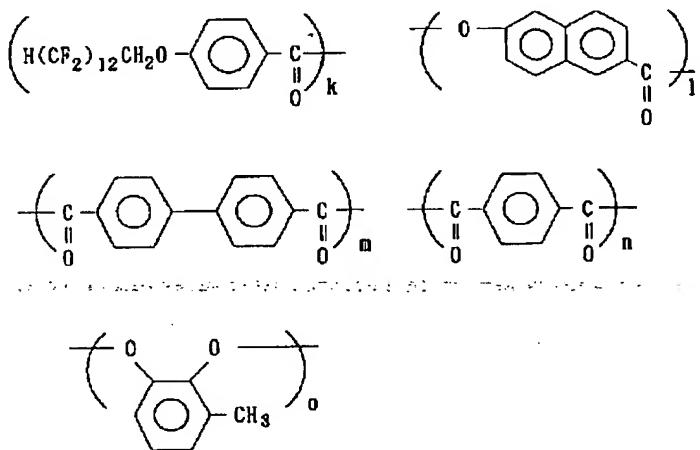


[0124] n+o=k/2+m+k/(l+m)=80 / 60 - 2/99 -- desirable -- 40/80-10/95 l/m=100 / 0 - 0/100 -- desirable -- 95/5-5/95 n/o=100 / 0 - 0/100 -- desirable -- 95/5-5/95k, and l, m, n and o -- respectively -- a mol -- a presentation ratio is shown.

[0125]

[Formula 50]

構造式 4-3

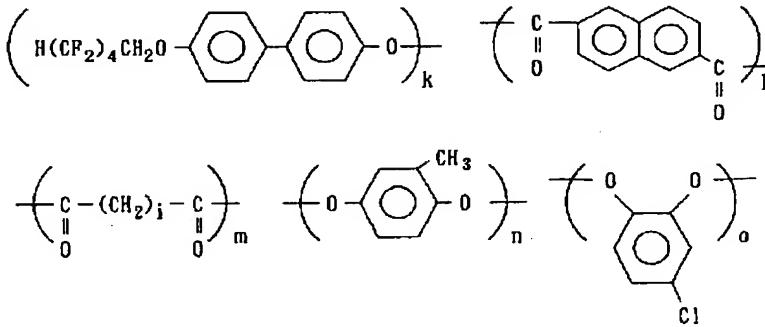


[0126] o=k/2+m+nk/(m+n)=80 / 60 - 2/99 -- desirable -- 40/80-10/95 m/n=100 / 0 - 0/100 -- desirable -- 95/5-5/95 l/o=20 / 10 - 0/10 -- desirable -- 15/10-5/10k, and l, m, n and o -- respectively -- a mol -- a presentation ratio is shown.

[0127]

[Formula 51]

構造式 4-4

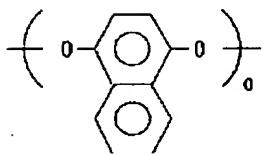
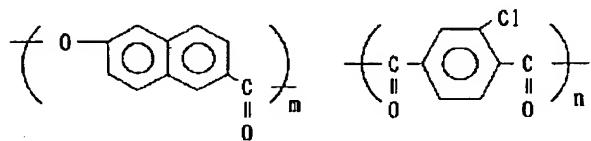
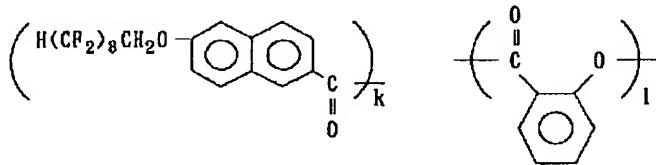


[0128] $l+m=k/2+n+ok/(n+o)=80 / 60 \cdot 2/99 \cdots$ desirable $\cdots 40/80 \cdot 10/95 l/m=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95 n/o=100 / 0 \cdot 0/100 \cdots 95/5 \cdot 5/95 i$ shows the integer of 2-12 preferably. $k, l, m, n,$ and o show a mol presentation ratio, respectively.

[0129]

[Formula 52]

構造式 4 5

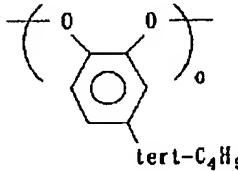
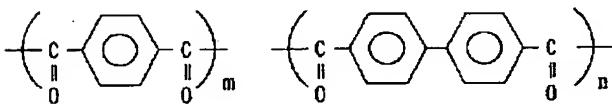
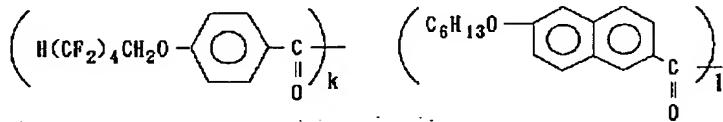


[0130] $o=k/2+nk/n=80 / 60 \cdot 2/99 \cdots$ desirable $\cdots 40/80 \cdot 10/95 l/m=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95(l+m)/o=20 / 10 \cdot 1/10 \cdots$ desirable $\cdots 15/10 \cdot 5/10 k,$ and l, m, n and o \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0131]

[Formula 53]

構造式 4 6

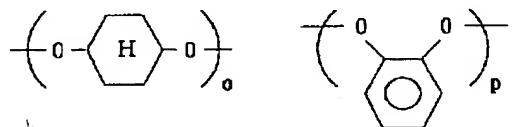
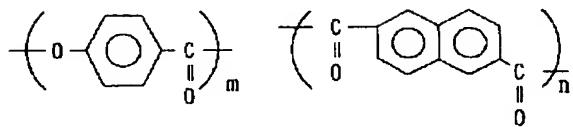
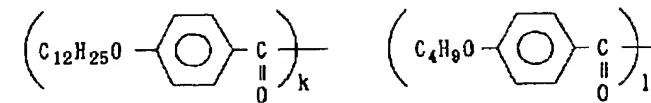
tert-C₄H₉

[0132] $o=k/2+l/2+m+n(k+l)/(m+n)=80 / 60 \cdot 2/99 \cdots$ desirable $\cdots 40/80 \cdot 10/95 k/l=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 90/10 \cdot 10/90 m/n=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5 \cdot 5/95 k,$ and l, m, n and o \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0133]

[Formula 54]

構造式 4 7



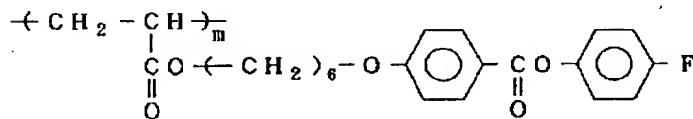
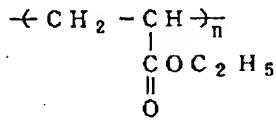
[0134] $o+p=k/2+l/2+n (k+l)$.. $n=80 / 60 \cdot 2/99$.. desirable .. $40/80 \cdot 10/95$ $k/l=100 / 0 \cdot 0/100$.. desirable .. $90/10 \cdot 10/90$ $o/p=100 / 0 \cdot 0/100$.. desirable .. $95/5 \cdot 5/95$ $m/n=20/ \dots 10 \cdot 0/10 \cdot 15/10 \cdot 5/10$ k , and l , m , n , o and p show a mol presentation ratio preferably, respectively.

[0135] **** is mentioned. moreover .. as the liquid crystallinity macromolecule of homeotropic orientation nature .. ** .. side-chain mold liquid crystallinity macromolecules, such as the side-chain mold liquid crystallinity macromolecule which has the unit which has substituents, such as an aromatic series radical which has a high substituent, an aromatic series radical which has a long-chain alkyl group, and an aromatic series radical which has a fluorine atom, as a side chain, for example, polyacrylate, polymethacrylate, a polysiloxane, and poly malonate, are also mentioned. The concrete example of structure is shown below.

[0136]

[Formula 55]

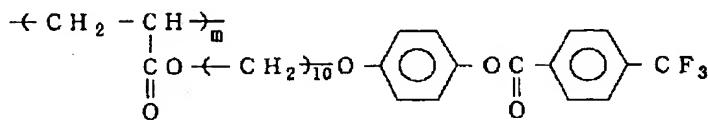
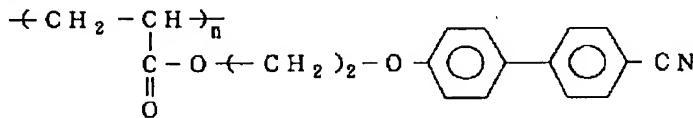
構造式 4 8



[0137] $n/m=80 / 20 \cdot 20/80$.. desirable .. $75 / 25 \cdot 25/75$ [0138]

[Formula 56]

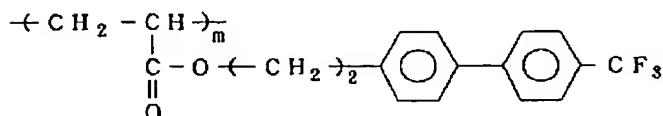
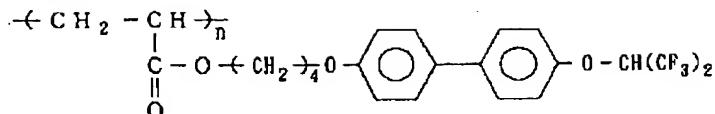
構造式 4 9



[0139] $n/m=80 / 20 \cdot 20/80$.. desirable .. $75 / 25 \cdot 25/75$ [0140]

[Formula 57]

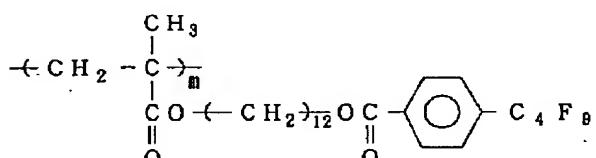
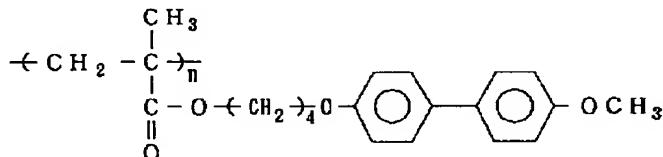
構造式 5 0



[0141] n/m=80 / 20 · 20/80 -- desirable -- 75 / 25 · 25/75 [0142]

[Formula 58]

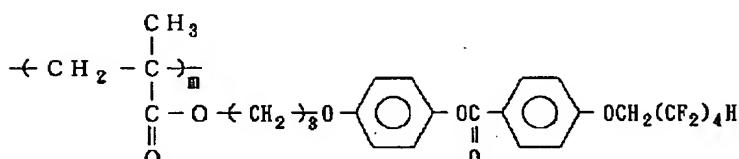
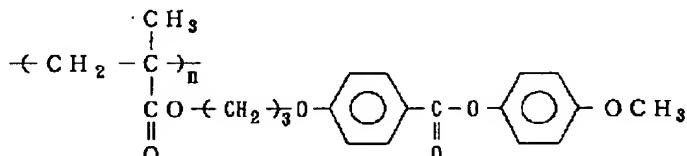
構造式 5 1



[0143] n/m=80 / 20 · 20/80 -- desirable -- 75 / 25 · 25/75 [0144]

[Formula 59]

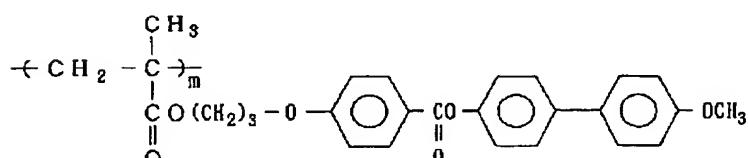
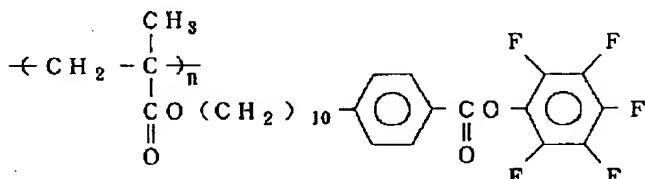
構造式 5 2



[0145] n/m=80 / 20 · 20/80 -- desirable -- 75 / 25 · 25/75 [0146]

[Formula 60]

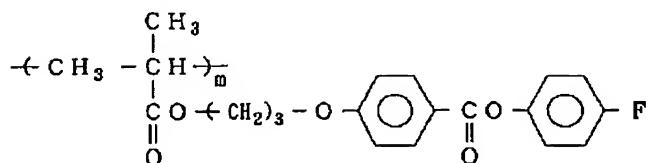
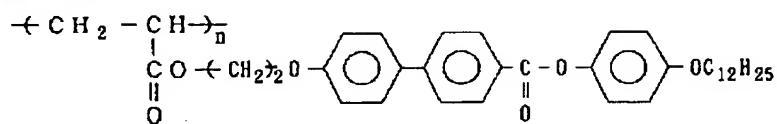
構造式 5 3



[0147] n/m=80 / 20 · 20/80 -- desirable -- 75 / 25 · 25/75 [0148]

[Formula 61]

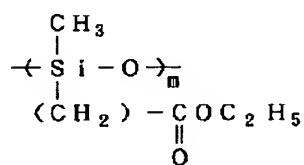
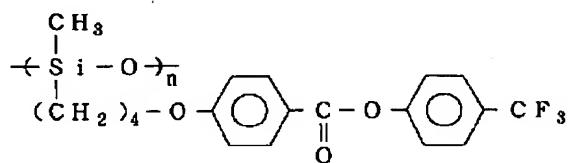
構造式 5 4



[0149] n/m=80 / 20 · 20/80 -- desirable -- 75 / 25 · 25/75 [0150]

[Formula 62]

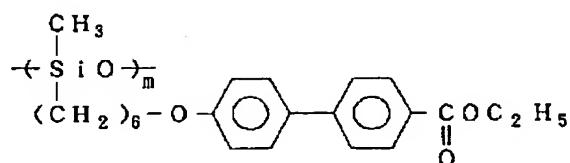
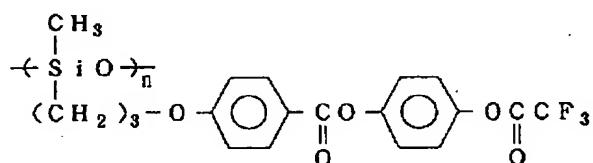
構造式 5 5



[0151] n/m=80 / 20 · 20/80 -- desirable -- 75 / 25 · 25/75 [0152]

[Formula 63]

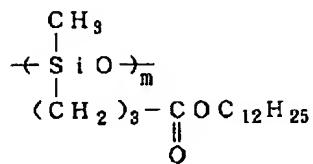
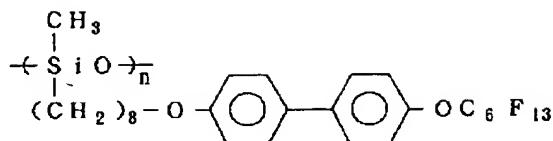
構造式 5 6



[0153] n/m=80 / 20 · 20/80 -- desirable -- 75 / 25 · 25/75 [0154]

[Formula 64]

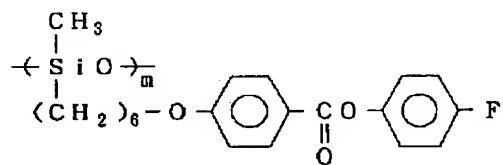
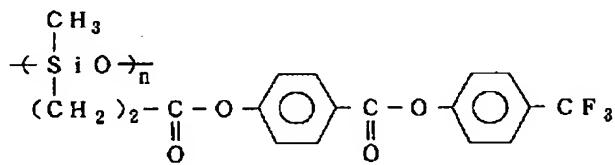
構造式 5 7



[0155] n/m=80 / 20 · 20/80 · desirable · 75 / 25 · 25/75 [0156]

[Formula 65]

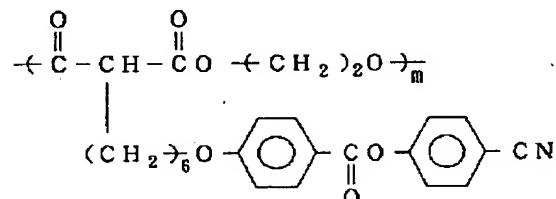
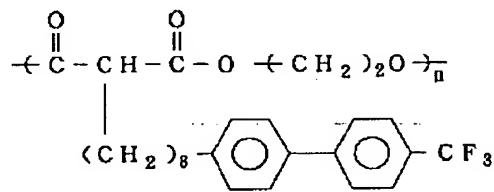
構造式 5 8



[0157] n/m=80 / 20 · 20/80 · desirable · 75 / 25 · 25/75 [0158]

[Formula 66]

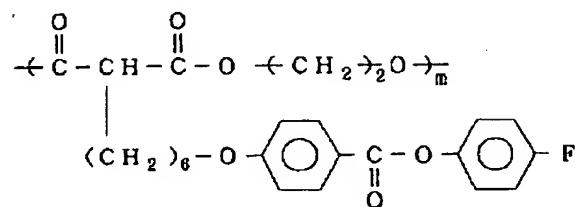
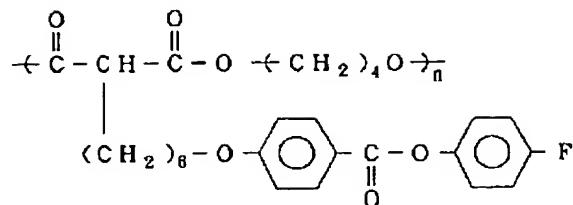
構造式 5 9



[0159] n/m=80 / 20 · 20/80 · desirable · 75 / 25 · 25/75 [0160]

[Formula 67]

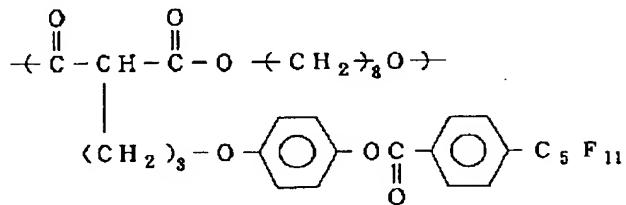
構造式 6 0



[0161] n/m=80 / 20 - 20/80 -- desirable -- 75 / 25 - 25/75 [0162]

[Formula 68]

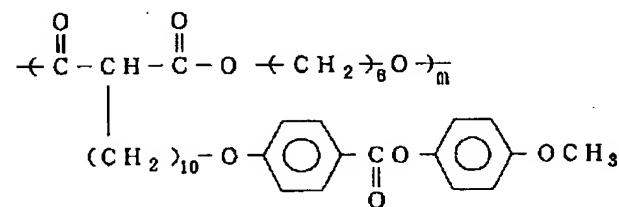
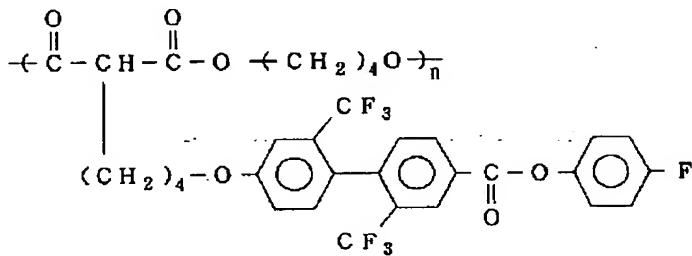
構造式 6 1



[0163] n/m=80 / 20 - 20/80 -- desirable -- 75 / 25 - 25/75 [0164]

[Formula 69]

構造式 6 2



[0165] n/m=80 / 20 - 20/80 -- desirable -- 75 / 25 - 25/75 [0166] the structural unit which constitutes the principal chain of the liquid crystallinity macromolecule of ** in the above-mentioned homeotropic orientation nature liquid crystallinity macromolecule -- ** -- the aromatic series radical which has a high substituent -- In the case of the principal chain mold liquid crystallinity macromolecule which has the aromatic series radical which has a long-chain alkyl group, the aromatic series radical which has a fluorine atom, molecular weight the logarithm measured at 30 degrees C among [various] the solvent, for example, a phenol / tetrachloroethane (60/40 (weight ratio)) mixed solvent, -- viscosity -- usually -- 0.05-2.0 -- it is the range of 0.07-1.0 preferably. a logarithm -- when viscosity is smaller than 0.05, there is a possibility that the mechanical strength of a compensation film may become weak. Moreover, when larger than 2.0, there is a possibility that homeotropic orientation nature may be lost. Moreover, when

larger than 2.0, there is a possibility that viscosity may become high too much in a liquid crystal condition, and even if it carries out a homeotropic orientation, the time amount which orientation takes may become long. And there is a possibility that nematic hybrid orientation may not be obtained at the time of the compensation film manufacture explained by the after-mentioned.

[0167] Moreover, in the end or both ends of a macromolecule chain of **, it has the long-chain alkyl group of carbon numbers 3·20, or the long-chain fluoro alkyl group of carbon numbers 2·20. In the case of the liquid crystallinity macromolecule which has the unit of one functionality guided from the compound which has one functionality parts, such as monoalcohol and monocarboxylic acid, molecular weight the logarithm measured at 30 degrees C among [various] the solvent, for example, a phenol / tetrachloroethane (60/40 (weight ratio)) mixed solvent, -- viscosity -- usually -- 0.04·1.5 -- it is the range of 0.06·1.0 preferably. a logarithm -- when viscosity is smaller than 0.04, the mechanical strength of a compensation film becomes weak. Moreover, when larger than 1.5, there is a possibility that homeotropic orientation nature may be lost. Moreover, there is a possibility that viscosity may become high too much in a liquid crystal condition, and even if it carries out a homeotropic orientation, the time amount which orientation takes may become long. And there is a possibility that nematic hybrid orientation may not be obtained at the time of the compensation film manufacture explained by the after-mentioned.

[0168] further -- the case of a side-chain mold liquid crystallinity giant molecule -- molecular weight -- polystyrene equivalent weight average molecular weight -- usually -- 1000·100,000 -- the range of 3000·50,000 is preferably desirable. It is [a possibility that the mechanical strength of a compensation film may become weak] and is not desirable when molecular weight is smaller than 1000. Moreover, when larger than 100,000, there is a possibility that homeotropic orientation nature may be lost. Moreover, it is [a possibility of producing the problem that there is a possibility that the solubility over the solvent of this liquid crystallinity macromolecule may fall, the solution viscosity of coating liquid becomes high too much in the case of the compensation film manufacture explained by the after-mentioned, and a uniform paint film cannot be obtained] and is not desirable when larger than 100,000.

[0169] Especially the synthesis method of the above-mentioned liquid crystallinity macromolecule is not restricted. This liquid crystallinity macromolecule is compoundable by the well-known polymerization method in the field concerned. For example, if liquid crystallinity polyester composition is taken for an example, it is compoundable by the melting polymerization method or the acid chloride method using the acid chloride of corresponding dicarboxylic acid.

[0170] In case the liquid crystallinity macromolecule concerned is compounded, a polymerization reaction is presented with the structural unit of one functionality by the monoalcohol and the monocarboxylic acid compounds which were explained previously and these functional derivatives, and the concrete target as a acetylation object, a halogenide, etc. The range of the liquid crystallinity giant molecule of this 1 functionality structural unit and the content specifically occupied in liquid crystallinity polyester is 2 / 201 · 80/240 in a mole fraction among the remaining amounts of constituents except a hydroxycarboxylic acid structural unit. It is the range of 10 / 205 · 20/220 more preferably. When the content of a 1 functionality structural unit is smaller than 2/210 (mole fraction), there is a possibility that liquid crystallinity polyester may not show homeotropic orientation nature. Moreover, when the content of a 1 functionality structural unit is larger than 80/240 (mole fraction), there is a possibility that the molecular weight of liquid crystallinity polyester may not go up to a desired value. Moreover, when a compensation film is produced, the mechanical strength of this film becomes weak and is not desirable. In addition, the content of the structural unit of one functionality responds to the charge of a monomer component.

[0171] Moreover, the liquid crystallinity macromolecule to which it is indicated that other orientation explained previously as a liquid crystallinity macromolecule in which optically uniaxial [forward] is shown in addition to the liquid crystallinity macromolecule of this homeotropic orientation nature, the non-liquid crystallinity macromolecule in which liquid crystallinity is not shown at all may be mixed suitably, and you may use as a constituent. using as this constituent -- ** -- there is an advantage which can control the average tilt angle of nematic hybrid orientation by accommodation of the presentation ratio free that stabilization of ** nematic hybrid orientation can be attained. However, if the liquid crystallinity giant molecule which was mixed and was used as the constituent shows optically uniaxial [forward] optically and does not form nematic hybrid orientation in the liquid crystal condition of this liquid crystallinity giant molecule, the compensation film used for this invention will not be obtained. In addition, in case it uses as a constituent, it is desirable to contain the liquid crystallinity macromolecule of homeotropic orientation nature explained above 5% of the weight or more. When fewer than 5 % of the weight, there is a possibility that nematic hybrid orientation may not be obtained.

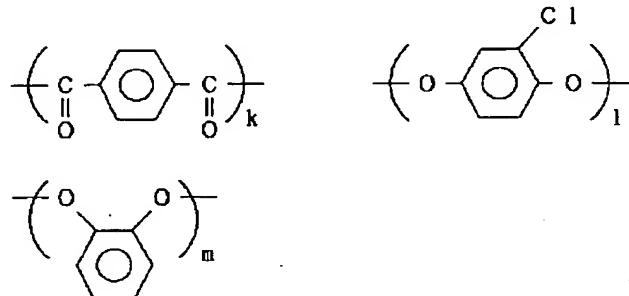
[0172] As the mixable macromolecule concerned, the liquid crystallinity macromolecule in which

orientation other than homeotropic orientation nature is usually shown is suitably mixed from a viewpoint of compatibility with the liquid crystallinity macromolecule of homeotropic orientation nature. As a class of liquid crystallinity macromolecule used, side-chain mold liquid crystallinity macromolecule; for example, polyacrylate, such as principal chain mold liquid crystallinity macromolecule; for example, polyester, polyimide, a polyamide, polyester, a polycarbonate, and polyester imide, polymethacrylate, a polysiloxane, poly malonate, etc. can be illustrated. Although it will not be limited especially if it has compatibility with the liquid crystallinity giant molecule of homeotropic orientation nature, on a homogeneous stacking tendency liquid crystallinity giant molecule and a twist concrete target, the polyester of a homogeneous stacking tendency, polyacrylate, polymethacrylate, etc. are desirable especially. The liquid crystallinity polyester which has the orthochromatic ([-izing 4]) permutation aromatic series unit illustrated previously especially in a principal chain is the most desirable. The concrete example of structure of the liquid crystallinity macromolecule which shows a homogeneous stacking tendency below is shown.

[0173]

[Formula 70]

構造式 6-3

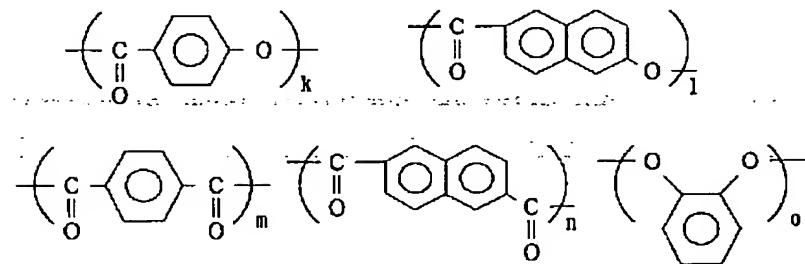


[0174] $k=l+m/m=80 / 20 \cdot 20/80 \cdots$ desirable $\cdots 75/25 \cdot 25/75k$, and l and m \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0175]

[Formula 71]

構造式 6-4

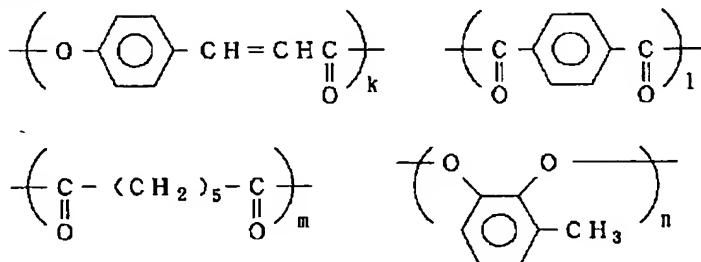


[0176] $o=m+n/(k+l) / o=20 / 10 \cdot 0/10 \cdots$ desirable $\cdots 15/10 \cdot 0/10 m/n=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 98/2 \cdot 2/98k$, and l , m , n and o \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0177]

[Formula 72]

構造式 6-5

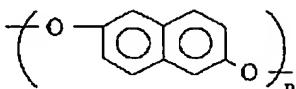
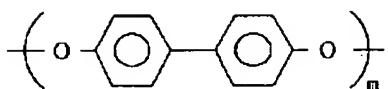
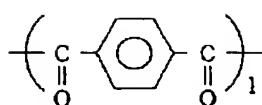
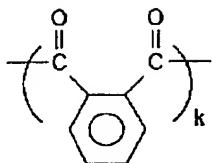


[0178] $n=l+mk/m=20 / 10 \cdot 0/10 \cdots$ desirable $\cdots 15/10 \cdot 0/10k$, l , m and n , and a *****mol \cdots a presentation ratio is shown.

[0179]

[Formula 73]

構造式 6 6

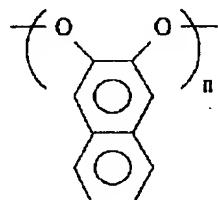
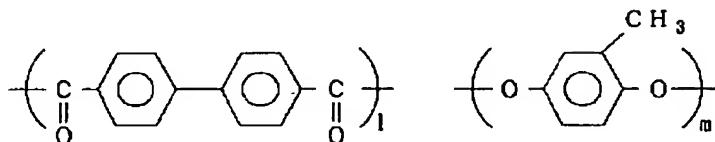
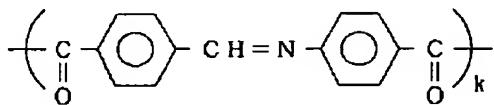


[0180] $k+l=m+n$ / 0 · 0/100 .. desirable .. 95/5·5/95 $m/l=100 / 0 \cdot 0/100$.. desirable .. 95/5·5/95, and l, m and n .. respectively .. a mol .. a presentation ratio is shown.

[0181]

[Formula 74]

構造式 6 7

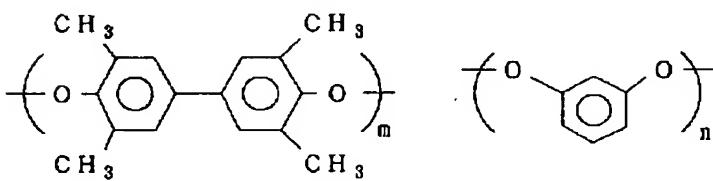
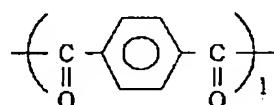
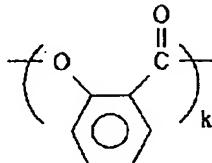


[0182] $k+l=m+n$ / 0 · 0/100 .. desirable .. 95/5·5/95 $m/n=100 / 0 \cdot 0/100$.. desirable .. 95/5·5/95, and l, m and n .. respectively .. a mol .. a presentation ratio is shown.

[0183]

[Formula 75]

構造式 6 8

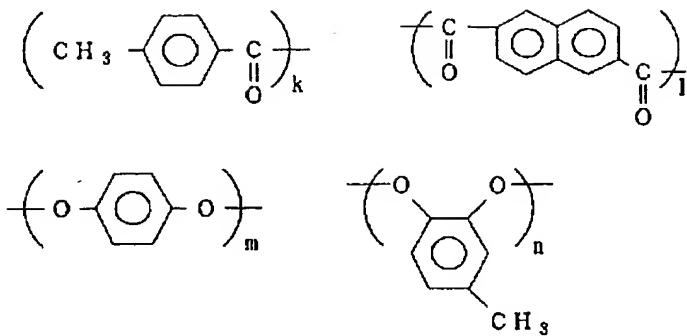


[0184] $l=m+n$ / 10 · 0/10 .. desirable .. 10/10·0/10 $m/n=100 / 0 \cdot 0/100$.. desirable .. 95/5·5/95, and l, m and n .. respectively .. a mol .. a presentation ratio is shown.

[0185]

[Formula 76]

構造式 6 9

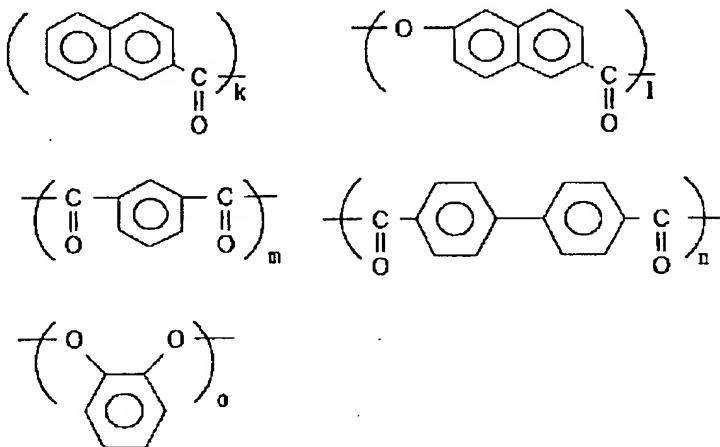


[0186] $m+n=k/2+l/k=l=40 / 80 - 0/100 \cdots$ desirable $\cdots 20/90-0/100 m/n=100 / 0 - 0/100 \cdots$ desirable $\cdots 95/5-5/95k$, and l, m and n \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0187]

[Formula 77]

構造式 7 0

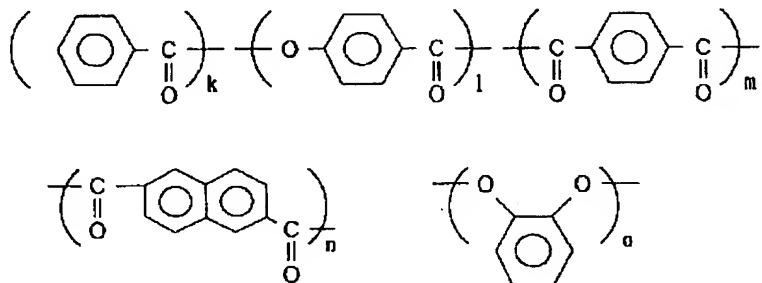


[0188] $o=k/2+m+nk/(m+n)=40 / 80 - 0/100 \cdots$ desirable $\cdots 20/90-0/100 m/n=100 / 0 - 0/100 \cdots$ desirable $\cdots 95/5-5/95 l/o=20 / 10 - 0/10 \cdots$ desirable $\cdots 15/10-5/10k$, and l, m, n and o \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0189]

[Formula 78]

構造式 7 1

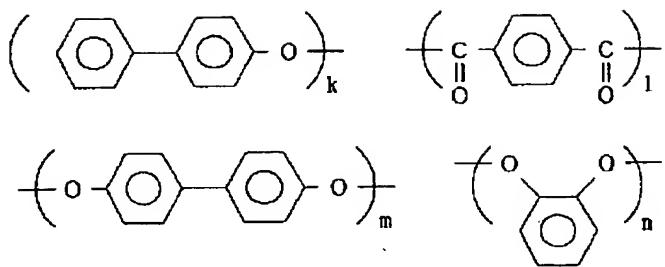


[0190] $o=k/2+m+nk/(m+n)=40 / 80 - 0/100 \cdots$ desirable $\cdots 20/90-0/100 m/n=100 / 0 - 0/100 \cdots$ desirable $\cdots 95/5-5/95 l/o=20 / 10 - 0/10 \cdots$ desirable $\cdots 15/10-5/10k$, and l, m, n and o \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0191]

[Formula 79]

構造式 7-2

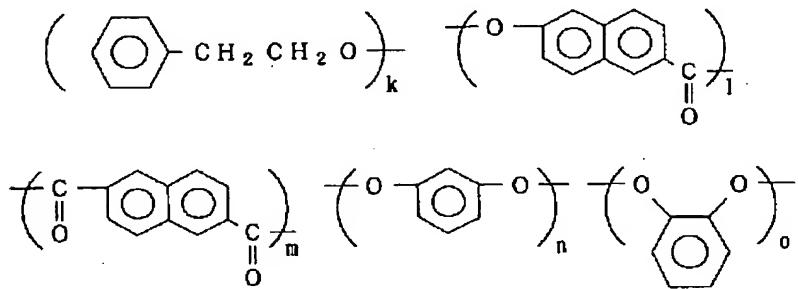


[0192] $l=k/2+m+nk/(m+n)=40 / 80 \cdot 0/100 \cdots \text{desirable} \cdots 20/90 \cdot 0/100 \quad m/n=100 / 0 \cdot 0/100 \cdots \text{desirable} \cdots 95/5 \cdot 5/95 \quad l/m=20 / 10 \cdot 0/10 \cdots \text{desirable} \cdots 15/10 \cdot 5/10 \quad k, \text{and } l, m \text{ and } n \cdots \text{respectively} \cdots \text{a mol} \cdots \text{a presentation ratio is shown.}$

[0193]

[Formula 80]

構造式 7-3

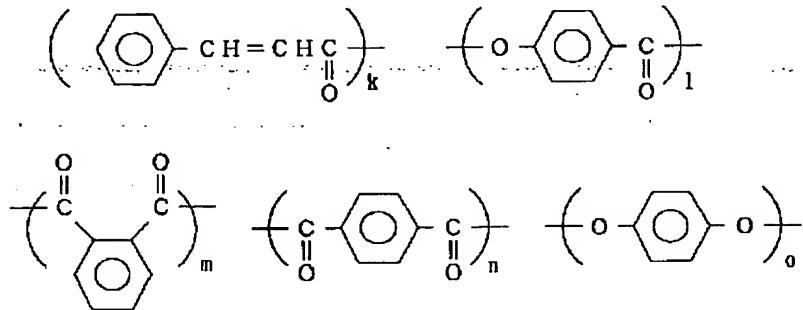


[0194] $m=k/2+n+ok/(n+o)=40 / 80 \cdot 0/100 \cdots \text{desirable} \cdots 20/90 \cdot 0/100 \quad n/o=100 / 0 \cdot 0/100 \cdots \text{desirable} \cdots 95/5 \cdot 5/95 \quad l/m=20 / 10 \cdot 0/10 \cdots \text{desirable} \cdots 15/10 \cdot 5/10 \quad k, \text{and } l, m, n \text{ and } o \cdots \text{respectively} \cdots \text{a mol} \cdots \text{a presentation ratio is shown.}$

[0195]

[Formula 81]

構造式 7-4

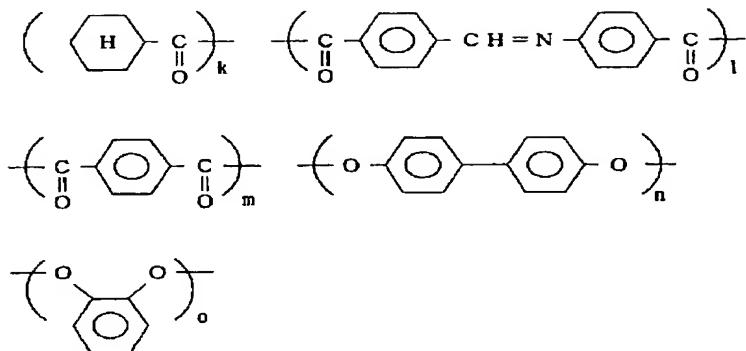


[0196] $o=k/2+m+nk/(m+n)=40 / 80 \cdot 0/100 \cdots \text{desirable} \cdots 20/90 \cdot 0/100 \quad m/n=100 / 0 \cdot 0/100 \cdots \text{desirable} \cdots 95/5 \cdot 5/95 \quad l/o=20 / 10 \cdot 0/10 \cdots \text{desirable} \cdots 15/10 \cdot 5/10 \quad k, \text{and } l, m, n \text{ and } o \cdots \text{respectively} \cdots \text{a mol} \cdots \text{a presentation ratio is shown.}$

[0197]

[Formula 82]

構造式 7-5



[0198] $n+o=k/2+l+mk/(l+m)=40 / 80 - 0/100 \cdots$ desirable $\cdots 20/90-0/100 l/m=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5-5/95 n/o=100 / 0 \cdot 0/100 \cdots$ desirable $\cdots 95/5-5/95k$, and l , m , n and o \cdots respectively \cdots a mol \cdots a presentation ratio is shown.

[0199] the logarithm which measured such molecular weight at 30 degrees C among [various] the solvent, for example, a phenol / tetrachloroethane (60/40 (weight ratio)) mixed solvent, in the case of the principal chain mold liquid crystallinity macromolecule $\cdots 0.05\text{-}3.0$ are desirable still more desirable, and the range of viscosity is usually $0.07\text{-}2.0$. a logarithm \cdots when viscosity is smaller than 0.05, there is a possibility that the mechanical strength of a compensation film may become weak. Moreover, when larger than 3.0, since there is a possibility that the viscosity at the time of liquid crystal formation may become high too much, and the time amount which orientation takes may become long or it checks a homeotropic orientation, it is not desirable.

[0200] moreover, the case of a side-chain mold liquid crystal polymer \cdots molecular weight \cdots polystyrene equivalent weight average molecular weight \cdots usually $\cdots 5000\text{-}200,000 \cdots$ the range of $10,000\text{-}150,000$ is preferably desirable. When molecular weight is smaller than 5000, there is a possibility that the mechanical strength of a compensation film may become weak. Moreover, it is [a possibility that the solubility over the solvent of a polymer falls and of producing the trouble on film production of the solution viscosity of coating liquid becoming high too much, and being unable to obtain a homogeneity paint film] and is not desirable when larger than 200,000.

[0201] Moreover, the judgment of a homogeneous stacking tendency is performed like the judgment of homeotropic orientation nature using this substrate that has not performed surface treatment, such as siliconizing, rubbing processing, and uniaxial-stretching processing. A liquid crystallinity giant-molecule layer is formed on this substrate, and it judges whether a homogeneous stacking tendency is shown according to the orientation condition.

[0202] Especially the synthesis method of the above-mentioned liquid crystallinity macromolecule is not restricted. This liquid crystallinity macromolecule is compoundable by the well-known polymerization method in the field concerned. For example, if polyester composition is taken for an example, it is compoundable by the melting polymerization method or the acid chloride method using the acid chloride of corresponding dicarboxylic acid.

[0203] In order to obtain the compensation film which fixed nematic hybrid orientation in homogeneity using the liquid crystallinity giant molecule which has optically uniaxial [like the above / forward], it is desirable in this invention to step on the orientation substrate explained below and each process.

[0204] First, an orientation substrate is explained. In order to obtain nematic hybrid orientation using a forward optically uniaxial liquid crystallinity giant molecule, it is desirable to insert the upper and lower sides of this liquid crystallinity giant-molecule layer by different interface. When the upper and lower sides are inserted by the same interface, the orientation in the vertical interface of this liquid crystallinity giant-molecule layer will become the same, and it will be difficult to obtain nematic hybrid orientation.

[0205] One orientation substrate and an air interface are used as a concrete mode. An orientation substrate is touched in the lower-bound side of a liquid crystallinity macromolecule layer, and the upper-bound side of this liquid crystallinity macromolecule layer is made to specifically touch air. Although the orientation substrate with which interfaces differ up and down can also be used, it is more desirable to use one orientation substrate and an air interface on a manufacture process.

[0206] As for the orientation substrate which can be used for this invention, it is desirable to have the anisotropy so that the sense (projection to the orientation substrate of a director) to which liquid crystal inclines can be specified. When the sense to which liquid crystal inclines cannot be specified, only the orientation leaning to disorderly bearing can be obtained (the vector which projected the director to this

substrate becomes disorderly).

[0207] What specifically has the anisotropy within a field as the above-mentioned orientation substrate is desirable. Polyimide, polyamidoimide, a polyamide, polyether imide, A polyether ether ketone, a polyether ketone, poly ketone sulfide, Polyether sulfone, polysulfone, polyphenylene sulfide, Polyphenylene oxide, polyethylene terephthalate, polybutylene terephthalate, Polyethylenenaphthalate, polyacetal, a polycarbonate, polyarylate, Acrylic resin, polyvinyl alcohol, polypropylene, cellulose system plastics, A plastic film substrate and uniaxial-stretching plastic film substrates, such as an epoxy resin and phenol resin, They are glass substrates, such as metal substrates, such as aluminum which attached the slit-like slot to the front face, iron, and copper, alkali glass which carried out etching processing of the front face at the shape of a slit, boro-silicated glass, and flint glass, etc.

[0208] The various above-mentioned substrates which have the rubbing plastic film substrate which performed rubbing processing to the above-mentioned plastic film substrate in this invention or the plastics thin film which performed rubbing processing, for example, the rubbing polyimide film, the rubbing polyvinyl alcohol film, etc., the various above-mentioned substrates which have the slanting vacuum evaporationo film of oxidation silicon etc. further can be used.

[0209] In the various above-mentioned orientation substrates, the various substrates which have the rubbing polyimide film, a rubbing polyimide substrate, a rubbing polyether ether ketone substrate, a rubbing polyether ketone group plate, a rubbing polyether sulfone substrate, a rubbing polyphenylene sulfide substrate, a rubbing polyethylene terephthalate substrate, a rubbing polyethylenenaphthalate substrate, a rubbing polyarylate substrate, and a cellulose plastic substrate can be mentioned as this suitable substrate for making it form in nematic hybrid orientation. Moreover, the direction of rubbing given to these substrates usually corresponds in the direction of a tilt of the compensation film explained previously.

[0210] As **** explained the compensation film used for the liquid crystal display component of this invention, the top face of this film differs in the include angle of the director of a liquid crystallinity macromolecule, and a film flat surface to make from an inferior surface of tongue. This include angle [/ near the interface of the film plane which touched the orientation substrate] is adjusted 60 degrees or more 0 times or more according to the approach of the orientation processing, or the class of liquid crystallinity macromolecule in one of the include-angle range of 50 or less degrees or 90 degrees or less. Usually, it is more desirable on a manufacture process to adjust the include angle of the director of this liquid crystallinity macromolecule and a film flat surface to make to the include-angle range of 50 or less degrees 0 times or more. [/ near the interface of the film plane which touched the orientation substrate]

[0211] This compensation film applies the liquid crystallinity macromolecule which shows optically uniaxial [forward] optically to homogeneity on the orientation substrate like the above, and, subsequently pass a homogeneity orientation process and the fixed process of an orientation gestalt. Spreading to the orientation substrate of this liquid crystallinity macromolecule can be performed in the state of melting which fused the solution condition or this liquid crystallinity macromolecule which usually dissolved this liquid crystallinity macromolecule in various solvents. Solution spreading is desirable on a manufacture process.

[0212] Solution spreading melts a liquid crystallinity macromolecule to a suitable solvent, and prepares the solution of predetermined concentration. As the above-mentioned solvent, according to the classes (presentation ratio etc.) of forward optically uniaxial liquid crystallinity macromolecule, although there is no ***** generally Usually, chloroform, dichloromethane, a carbon tetrachloride, a dichloroethane, Tetrachloroethane, a trichloroethylene, tetrachloroethylene, Halogenated hydrocarbon, such as a chlorobenzene and an orthochromatic dichlorobenzene Phenols, such as a phenol and parachlorohenol, benzene, Aromatic hydrocarbon, such as toluene, xylene, methoxybenzene, 1, and 2-JIMETOKI benzene An acetone, ethyl acetate, tert-butyl alcohol, a glycerol, Ethylene glycol, triethylene glycol, ethylene glycol monomethyl ether, Diethylene-glycol wood ether, ethyl Cellosolve, butyl Cellosolve, 2-pyrrolidone, a N-methyl-2-pyrrolidone, a pyridine, triethylamine, These mixed solvents, for example, a mixed solvent with halogenated hydrocarbon and phenols etc., such as a tetrahydrofuran, dimethylformamide, dimethylacetamide, dimethyl sulfoxide, an acetonitrile, butyronitrile, and a carbon disulfide, are used.

[0213] Although the concentration of a solution does not generally have ***** in order to be dependent on the solubility of the forward optically uniaxial liquid crystallinity macromolecule to be used, or the thickness of a compensation film finally made into the purpose, it is usually used in 3 - 50% of the weight of the range, and is 7 - 30% of the weight of the range preferably.

[0214] It applies on the orientation substrate which explained below the forward optically uniaxial liquid crystallinity polymer solution adjusted to desired concentration using the above-mentioned solvent by ****. As the approach of spreading, a spin coat method, the roll coat method, the printing method, the

immersion Czochralski method, the curtain coat method, etc. are employable.

[0215] A solvent is removed after spreading and the layer of the uniform liquid crystallinity macromolecule of thickness is made to form on an orientation substrate. If especially solvent removal conditions are not limited, but a solvent can remove them in general, the layer of a liquid crystallinity macromolecule does not flow or they are not carried out having even flowed and fallen enough, they are good. Usually, a solvent is removed using desiccation at a room temperature, desiccation with a drying furnace, blasting of warm air or hot blast, etc.

[0216] As for the phase of this spreading / desiccation process, it is the purpose first to make the layer of a liquid crystallinity giant molecule form in homogeneity on a substrate, and this liquid crystallinity giant molecule has not formed nematic hybrid orientation yet. the following heat treatment process -- mono-- domain nematic hybrid orientation is completed.

[0217] In forming nematic hybrid orientation by heat treatment, the lower one of the viscosity of a forward optically uniaxial liquid crystallinity macromolecule is good in the semantics which helps the orientation by the interface effectiveness. Therefore, the higher one of heat treatment temperature is desirable. Moreover, the average tilt angle obtained depending on a liquid crystallinity giant molecule may change with heat treatment temperature. In that case, in order to obtain the average tilt angle according to the purpose, it is necessary to set up heat treatment temperature. For example, in order to obtain the orientation which has a certain tilt angle, when it is necessary to heat-treat at comparatively low temperature, at low temperature, the viscosity of a liquid crystallinity macromolecule is high and the time amount which orientation takes becomes long. in such a case -- once -- an elevated temperature -- heat treating -- mono-- after obtaining domain orientation, the approach of lowering to the temperature aiming at the temperature of heat treatment gradually becomes effective gradually. Anyway, it is desirable to heat-treat at the temperature more than a glass transition point according to the property of a liquid crystallinity macromolecule which shows optically uniaxial [forward] optically of using. The range of 50 degrees C - 300 degrees C, especially the range of 100 degrees C - 260 degrees C are usually suitable for heat treatment temperature.

[0218] since [moreover,] heat treatment time amount required in order that a liquid crystallinity macromolecule may carry out sufficient orientation on an orientation substrate changes with the classes (for example, presentation ratio etc.) of this liquid crystallinity macromolecule to be used, and heat treatment temperature -- generally -- yes -- although not obtained -- usually -- the range for 10 seconds - 120 minutes -- the range for 30 seconds - 60 minutes is especially desirable. When shorter than 10 seconds, there is a possibility that orientation may become inadequate. Moreover, it is [a possibility that productivity may fall] and is not desirable when longer than 120 minutes.

[0219] Thus, uniform nematic hybrid orientation can be first obtained over the whole orientation substrate top surface in the state of liquid crystal.

[0220] In addition, in the above-mentioned heat treatment process, it does not matter in order to carry out nematic hybrid orientation of the liquid crystallinity giant molecule, especially even if it uses a magnetic field and electric field. However, when a magnetic field and electric field are impressed heat-treating, in order that the force of a uniform place may work to a liquid crystallinity macromolecule, the director of this liquid crystal becomes easy to turn to a fixed direction during impression. That is, the nematic hybrid orientation which forms the include angle from which a director differs according to the direction of thickness of a film becomes like this invention that it is hard to be obtained. Although stable nematic hybrid orientation can be thermally obtained if the force of a place is removed after making the HOMEOTORO pick except nematic hybrid orientation, homogeneous orientation, or the other orientation once form, there is especially no merit on a process.

[0221] In this way, it can fix by cooling next the nematic hybrid orientation formed in the liquid crystal condition to the temperature below the liquid crystal transition point of the liquid crystallinity macromolecule concerned, without spoiling the homogeneity of this orientation at all.

[0222] If the above-mentioned cooling temperature is the temperature below the liquid crystal transition point, there will be especially no limit. For example, by cooling in temperature lower 10 degrees C than the liquid crystal transition point, uniform nematic hybrid orientation is fixable. Especially a limit does not have the means of cooling and it is fixed only by taking out of the heating ambient atmosphere in a heat treatment process into the ambient atmosphere below the liquid crystal transition point, for example, a room temperature. Moreover, in order to raise the effectiveness of production, forced cooling, such as air cooling and water cooling, and gradual cooling may be performed. However, the average tilt angles obtained with a cooling rate depending on a forward optically uniaxial liquid crystallinity giant molecule may differ a little. When it is necessary to use this such liquid crystallinity giant molecule, and to control an average tilt angle strictly, it is desirable to also perform cooling actuation in consideration of

cooling conditions suitably.

[0223] Subsequently, the include-angle control in the direction of film thickness of nematic hybrid orientation is explained. The include angle of the director of a liquid crystallinity macromolecule and a film flat surface to accomplish is controllable at a desired include angle, respectively by choosing suitably the class of liquid crystallinity macromolecule to be used, a presentation ratio, etc. an orientation substrate, heat treatment conditions, etc. Moreover, also after fixing nematic hybrid orientation, it is controllable at a desired include angle by using the approach of deleting a film front face to homogeneity, for example of dipping in a solvent and melting a film front face to homogeneity etc. In addition, the solvent used in this case must be suitably chosen according to the class of liquid crystallinity macromolecule, and the class of orientation substrate.

[0224] Since the compensation film obtained according to the above process does orientation and immobilization of the orientation gestalt of nematic hybrid orientation at homogeneity and this orientation is formed, the upper and lower sides of this film are not equivalent, and there is an anisotropy also in field inboard.

[0225] Moreover, the gestalt of carrying out the laminating of the compensation film to another different substrate from ** orientation substrate used where [as it is] ** orientation substrate is formed on ** orientation substrate which exfoliates from this film and is used with a compensation film simple substance as a use gestalt at the time of arranging between TN liquid crystal cell, a top, and/or a bottom polarizing plate as **** explained this compensation film, and using it for it is mentioned. In addition, when using in the condition of ** and **, in order that an orientation substrate may obtain nematic hybrid orientation, it is required, but when this substrate that can have effect which is not desirable as TN-LCD is used, the orientation substrate can be removed after nematic hybrid orientation immobilization. Even if the compensation film after the orientation immobilization used for this invention removes an orientation substrate, orientation turbulence etc. does not take place. As mentioned above, in the liquid crystal display of this invention, you may be the compensation film which has which gestalt.

[0226] Moreover, this compensation film can also prepare protective layers, such as transparence plastic film, for the purposes, such as a surface protection, an increment on the strength, and improvement in environmental dependability. Moreover, as a protective layer, on the quality of the optical character, plastic plates, such as a desirable substrate, for example, polymethacrylate, a polycarbonate, polyvinyl alcohol, polyether sulfone, polysulfone, polyarylate, polyimide, amorphous polyolefine, and triacetyl cellulose, are stuck, and can also be used through the adhesives or the binder of optical grade.

[0227] Next, the arrangement in the case of combining with TN liquid crystal cell which explained the compensation film of this invention previously is explained concretely. The arrangement location of this compensation film can arrange the compensation film of one sheet or two or more sheets that what is necessary is just to be between a polarizing plate and TN liquid crystal cell. It is desirable practically to perform-angle-of-visibility compensation in this invention using the compensation film of one sheet or two sheets. Even if it uses the compensation film of three or more sheets, although angle-of-visibility compensation is possible, since it leads to a cost rise, it cannot be said that it is not much desirable. It is as follows when a concrete arrangement location is illustrated. However, these are strictly typical arrangement locations and this invention is not limited to these.

[0228] First, with the direction of a tilt of the compensation film in this invention, it is defined as the projection direction of the director of this liquid crystallinity macromolecule in the field among the 2nd page of the upper and lower sides of this film where the include angle of the director of this liquid crystallinity macromolecule and a film flat surface to accomplish is smaller. Specifically in drawing 1, the 2nd page of the upper and lower sides of this compensation film is assumed to be the b-th page and the c-th page. The include angle of the director of a liquid crystallinity macromolecule and film flat surface by the side of the b-th page of this compensation film and the c-th page to accomplish is the relation of the include angle by the side of include-angle > the c-th page by the side of the b-th page. Subsequently, the direction which becomes are the direction where the include angle of the director by the side of the b-th page and the director by the side of the c-th page to accomplish serves as an acute angle when the c-th page is seen in the direction of film thickness from the b-th page of this compensation film, and parallel [the projection component to the film flat surface of the director by the side of the b-th page and the director by the side of the c-th page] is defined as the direction of a tilt of a compensation film by this invention.

[0229] Subsequently, the direction of a pre tilt of TN liquid crystal cell is defined as follows. Usually, the nematic liquid crystal in TN liquid crystal cell leans with [it is not parallel and] a certain include angle to the cel substrate interface like drawing 2 (when the twist angle of a nematic liquid crystal is 0 times). In this condition, the direction which is a direction whose include angle of the director of this liquid

crystal and a liquid crystal cell substrate flat surface to accomplish is an acute angle and where the projection component of this director is parallel is defined as the direction of a pre tilt by this invention. Therefore, the direction of a pre tilt is defined as the liquid crystal cell substrate of the upper and lower sides in TN liquid crystal cell an one direction every, respectively, as shown in drawing 2.

[0230] The case where one compensation film is arranged first is explained. A compensation film may be arranged between a polarizing plate and TN liquid crystal cell, may be the top-face side of the liquid crystal cell concerned, and may be an inferior-surface-of-tongue side. The direction of a tilt of a compensation film and the liquid crystal cell substrate with which this compensation film approached most usually [165 - 195] arrange especially the include angle with the direction of a pre tilt in the cel substrate of the opposite side to accomplish in 175 - 185 degrees preferably 170 to 190 degrees in the case of this arrangement. That is, when the compensation film is arranged on the top face of TN liquid crystal cell and the lower include angle to accomplish and a lower compensation film with the direction of a pre tilt in this liquid crystal cell substrate are arranged on the inferior surface of tongue of TN liquid crystal cell, the include angle with the direction of a pre tilt in a top liquid crystal cell substrate to accomplish is arranged so that the above-mentioned include-angle range may be filled. When not filling the above-mentioned include-angle range, sufficient angle-of-visibility compensation effect is not acquired.

[0231] Next, the case where these two compensation films are arranged is explained. When arranging a two-sheet compensation film, two sheets may be arranged two sheets between the same sides, for example, TN liquid crystal cell and a top polarizing plate, or between this liquid crystal cell and a bottom polarizing plate. Moreover, one sheet may be arranged between a top and a bottom polarizing plate, and TN liquid crystal cell, respectively. In addition, this film with which what has the same optical parameter may be used, and optical parameters differ may be used for the compensation film of two sheets.

[0232] The case where one sheet is arranged, respectively between [each] a top and a bottom polarizing plate, and TN liquid crystal cell is explained. In this arrangement, each compensation film is made the same arrangement as the case where one above-mentioned sheet is arranged. That is, the include angle with the direction of a pre tilt in a cel substrate with opposite direction of a tilt of each compensation film and substrate of TN liquid crystal cell with which the compensation film approached to accomplish is usually [165 - 195] especially arranged in the range of 175 - 185 degrees preferably 170 to 190 degrees.

[0233] Subsequently, the case where the compensation film of two sheets is arranged is explained to either between TN liquid crystal cell, a top, or a bottom polarizing plate. In addition, the compensation film arranged between a film 1, this film 1, a top, or a bottom polarizing plate in the compensation film arranged in the location which approached TN liquid crystal cell most is assumed to be a film 2. About the film 1 which approached TN liquid crystal cell most in this arrangement, it arranges like the conditions which arrange the above-mentioned compensation film of one sheet. That is, the direction of a tilt of a film 1 and the substrate of TN liquid crystal cell with which the film 1 approached most usually [165 - 195] arrange especially the include angle with the direction of a pre tilt in the cel substrate of the opposite side to accomplish in 175 - 185 degrees preferably 170 to 190 degrees. Subsequently, the arrangement conditions of the film 2 arranged between a film 1, a top, or a bottom polarizing plate are explained. A film 2 arranges especially the include angle with the direction of a pre tilt in a cel substrate contrary to this cel substrate made into criteria to accomplish in the range of 175 - 185 degrees preferably 170 to 190 degrees 165 to 195 degrees, in case a film 1 is the direction of a pre tilt of the cel substrate of TN liquid crystal cell which approached most, i.e., the arrangement conditions of a film 1.

[0234] Subsequently, arrangement of a polarizing plate is explained. Usually, in TN-LCD, a rectangular cross or the case where it arranges in parallel has the transparency shaft of a vertical polarizing plate mutually. Moreover, when arranging so that the transparency shaft of a vertical polarizing plate may intersect perpendicularly mutually, the transparency shaft of a polarizing plate and the direction of rubbing given to TN liquid crystal cell substrate of the side near a polarizing plate may be arranged so that a rectangular cross, parallel, or the include angle of 45 degrees may be made. In the liquid crystal display of this invention, when equipping with a polarizing plate on a compensation film, especially this arrangement may not be limited but may be arrangement [which] among the above. It is desirable a rectangular cross or to arrange in parallel the direction of rubbing which the transparency shaft of a vertical polarizing plate intersected perpendicularly mutually with the liquid crystal display of this invention especially, and was given to TN liquid crystal cell substrate of the side near the transparency shaft of a polarizing plate and a polarizing plate.

[0235] As mentioned above, this invention can obtain the liquid crystal display concerned which a raise in contrast which is not in the former as a TSUISUTEDDO nematic liquid crystal display using a TFT component or an MIM component, and wide-field-of-view cornification accomplished by arranging the compensation film which fixed nematic hybrid orientation in TN liquid crystal cell which has a specific

optical parameter.

[0236]

[Example] Although an example is described below, this invention is not restricted to these. In addition, each analysis method used in the example is as follows.

(1) The decision polymer of a presentation of a liquid crystallinity macromolecule was dissolved in deuteration chloroform or deuteration trifluoroacetic acid, and it measured and determined by 400MHz 1 H-NMR (JEOL JNM-GX400).

(2) a logarithm -- it measured at 30 degrees C using the measurement Ubbelohde viscometer of viscosity among the phenol / tetrachloroethane (60/40-fold quantitative ratio) mixed solvent.

(3) Decision DSC (Perkin Elmer DSC-7) measurement and optical microscope (BH2 made from Olympus Optics polarization microscope) observation of a liquid crystal phase sequence determined.

(4) The refractive index was measured with the measurement Abbe refractometer (Typemade from ATAGO-4) of a refractive index.

(5) It carried out using ellipsometer DVA-36VWLD made from polarization analysis Mizojiri Optical Co., Ltd. industry.

(6) Thickness measurement Kosaka Laboratory, Ltd. make High precision thin film level difference measuring instrument ET-10 were used. Moreover, the approach of asking for thickness from the data of interference wave measurement ([by Jasco Corp.] ultraviolet, visible, and near-infrared spectrophotometer V-570) and a refractive index was also used together.

[0237] Example <composition of liquid crystallinity polyester> of reference 6-hydroxy-2-naphthoic acid 100mmol, terephthalic acid 100mmol, chlorohydroquinone 50mmol, tert-butyl catechol 50mmol and acetic anhydride The acetylation reaction was performed at 140 degrees C under nitrogen-gas-atmosphere mind for 2 hours using 600mmol. It performed at 280 degrees C and 300 degrees C performed the polymerization at 270 degrees C succeedingly for 2 hours for 2 hours for 2 hours. Next, after dissolving the acquired resultant in tetrachloroethane, the methanol reprecipitated and refined and liquid crystallinity polyester (formula (1)) 40.0g was obtained. the logarithm of this liquid crystallinity polyester -- viscosity had a nematic phase as 0.35 and a liquid crystal phase, isotropic phase-liquid crystal phase transition temperature was 300 degrees C or more, and the glass transition point was 135 degrees C.

[0238] <Stacking tendency trial of liquid crystallinity polyester> 10wt(s)% the phenol / tetrachloroethane mixed solvent (6/4-fold quantitative ratio) solution were prepared using this liquid crystallinity polyester. After having applied with screen printing on the soda glass plate, drying and heat-treating this solution at 230 degrees C for 30 minutes, it cooled and fixed under the room temperature. The film 1 which carried out orientation to the homogeneity of 20 micrometers of thickness was obtained. When conoscope observation was carried out, it became clear that this liquid crystallinity polyester showed optically optically uniaxial [forward]. Moreover, it became clear that the polyester concerned had homeotropic orientation nature.

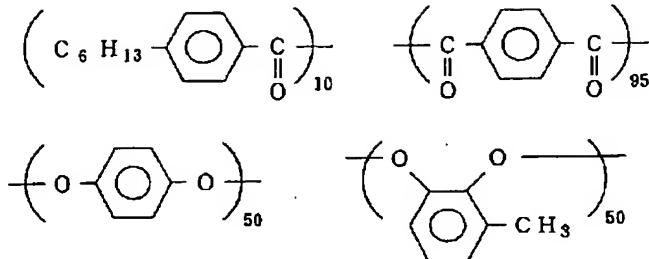
[0239] <Confirmation operation [of oriented structure] **> The 8wt% tetrachloroethane solution of the liquid crystallinity polyester of a formula (1) was prepared, and it applied with the spin coat method on the glass which has the rubbing polyimide film, and the film 2 was obtained, as a result of carrying out air cooling and fixing, after drying and heat-treating for 30 minutes at 250 degrees C. The film 2 on the obtained substrate was transparent, there was no orientation defect, it was uniform and thickness was 2.0 micrometers.

[0240] Using the optical measurement system shown in drawing 3 and drawing 4, the film 2 is leaned in the direction of rubbing of an orientation substrate, and the retardation value was measured. Consequently, the result which does not have the include angle from which it is right-and-left asymmetry like drawing 5, and a retardation value is set to 0 was obtained. The director of liquid crystallinity polyester leans to the substrate, and this result showed that it was not homogeneity tilt orientation (orientation condition with the angle fixed in the direction of thickness which a director and a substrate front face make).

[0241]

[Formula 83]

式 (1)



[0242] <confirmation operation [of oriented structure] **> -- subsequently -- the film 2 on a substrate -- five sheets -- carving -- respectively -- fixed time amount chloroform -- 5wt(s)% -- it was immersed in the included methanol solution and elution was carried out from the liquid crystal layer top face. When immersion time amount was made into 15 seconds, 30 seconds, 1 minute, 2 minutes, and 5 minutes, the thickness of the liquid crystal layer which remained without being eluted was 1.5 micrometers, 1.2 micrometers, 1.0 micrometers, 0.8 micrometers, and 0.5 micrometers, respectively. The retardation value in theta= 0 times (transverse-plane retardation value) was measured using the optical system of drawing 3 and drawing 4, and the relation between thickness and a retardation value was obtained (drawing 6). Thickness and a retardation value are not in straight-line relation so that drawing 6 may show, and this also showed that it was not homogeneity tilt orientation. The dotted line in drawing is a straight line observed in the film which carried out homogeneity tilt orientation.

[0243] <Confirmation operation [of oriented structure] **> Next, orientation and immobilization of the liquid crystallinity polyester of a formula (1) were done using the same approach as the above on the high refractive-index glass substrate (a refractive index is 1.84) which has the rubbing polyimide film, and the film 3 was produced. Refractometry was performed using the obtained film 3. When the film 3 had been arranged so that a glass substrate may touch the prism side of a refractometer, there was an anisotropy in the refractive index in a film plane, the refractive index within 1.56 and an parallel field of the refractive index within a field perpendicular to the direction of rubbing was 1.73, and the refractive index of the direction of thickness was not depended in the direction of a film 3, but was fixed at 1.56. From this, it became clear that flat-surface orientation of the liquid crystal molecule of the shape of a rod which constitutes liquid crystallinity polyester from a glass substrate side was carried out in parallel to a substrate. Next, when it had arranged so that the air interface side of a film 3 may touch the prism side of a refractive-index meter, there was no anisotropy in the refractive index within a field, the refractive index was fixed at 1.56, and the refractive index of the direction of thickness was not depended in the direction of a film 3, but was fixed at 1.73. It became clear that the liquid-crystal molecule of the shape of a rod which constitutes liquid crystallinity polyester from an air interface side was carrying out orientation from this perpendicularly to a substrate flat surface.

[0244] From actuation of ** to ** of a more than, the film formed from the liquid crystallinity polyester of a formula (1) formed nematic hybrid orientation, and it was imagined as what is carrying out orientation according to the restraining force of the substrate interface by rubbing, and the restraining force of an air interface as shown in drawing 7.

[0245] <Presumption of the include angle of the director and substrate flat surface in the analysis and the orientation substrate interface of the direction of a tilt to accomplish> On the film 3 formed on the high refraction glass substrate which has the rubbing polyimide film, the glass substrate which has the one more sheet rubbing polyimide film was put and stuck. That is, the film 3 was made the configuration inserted by the rubbing polyimide film of two sheets. In addition, it has arranged so that the direction of rubbing of the up-and-down rubbing film may become 180 each other. It heat-treated for 30 minutes at 230 degrees C by this condition. Refractometry and polarization analysis were performed about such an obtained sample film. As a result of refractometry, this sample film was related up and down, the same value was acquired, and the refractive index in a film plane was 1.56 in the direction of thickness of 1.73 and this film in 1.56 and an parallel field in the field perpendicular to the direction of rubbing. As for this, near the interface of a substrate, the upper and lower sides of a sample film showed that directors were abbreviation parallel to a substrate flat surface. Furthermore, refractive-index structure was optically uniaxial [almost forward] as a result of polarization analysis, and as a result of performing detailed analysis based on the crystal rotation method, near the substrate interface, the director leaned slightly. Moreover, the include angle of a substrate flat surface and a director to accomplish was about 3 times. The sense to which a director furthermore inclines was in agreement with the direction of rubbing (the

direction of a tilt and the direction of rubbing of a film are in agreement).

[0246] From the above thing, if it thinks that the director in a substrate interface is mostly decided by the interaction of liquid crystallinity polyester and an orientation substrate interface, it will be presumed that the include angle of the director and film flat surface in the substrate interface of the film 3 formed on one above-mentioned orientation substrate to accomplish is 3 times.

[0247] The liquid crystallinity polyester [which was used in the example 1 of example 1 reference / 5wt(s)% of] (formula (1)) tetrachloroethane solution was prepared. This solution was applied to the glass substrate which has the rubbing polyimide film with the spin coat method, and the solvent was removed. It heat-treated for 30 minutes at 250 degrees C after that. Then, it cooled and the orientation of the polyester concerned was fixed. In this way, it has nematic hybrid oriented structure, and the film 4 on the obtained glass substrate was transparent, and an orientation defect does not have it and it had uniform thickness (0.85 micrometers). Moreover, an average tilt angle is 44 degrees and the direction of a tilt was in agreement with the direction of rubbing.

[0248] Using the film 4 formed on the glass substrate which has this rubbing polyimide film two sheets, it has arranged to the upper and lower sides of TN cel so that it may become axial arrangement of drawing 8. In addition, both the films 1 of the upper and lower sides of the cel concerned have arranged the glass substrate side of this film so that a cel substrate may be approached. The cel parameters of used TN cel were cel GYABBU4.2micrometer, deltan=395nm, 90 angle of torsion (left hand), and three pre tilt angles, using ZLI-4792 (deltan=0.094) as a liquid crystal ingredient. Moreover, the direction of a pre tilt was in agreement in the direction of rubbing of a liquid crystal cell substrate. The electrical potential difference was impressed by the 300Hz square wave to the TN cel concerned. white -- the ratio (white display) of the permeability of display 0V and black display 6V -- / (black display) -- a contrast ratio -- carrying out -- the contrast ratio measurement from an omnidirection -- the Hamamatsu Photonics make -- contrast curves, such as a deed, were drawn using FFP optical system DVS-3000. The result was shown in drawing 9.

[0249] The liquid crystallinity polyester of example 2 formula (2) and a formula (3) was compounded. the logarithm of the liquid crystallinity polyester of a formula (2) -- viscosity had the nematic phase as 0.10 and a liquid crystal phase, and isotropic phase-liquid crystal phase transition temperature was 180 degrees C. As a result of performing the same stacking tendency trial as an example 1, it became clear that the liquid crystallinity polyester of a formula (2) showed homeotropic orientation nature, and showed optically uniaxial [forward] optically.

[0250] the logarithm of the liquid crystallinity polyester of a formula (3) -- viscosity had the nematic phase as 0.18 and a liquid crystal phase, and isotropic phase-liquid crystal phase transition temperature was 300 degrees C or more. As a result of performing the same stacking tendency trial as an example 1, it became clear that the liquid crystallinity polyester of a formula (3) showed a homogeneous stacking tendency.

[0251] The 8wt(s)%-N-methyl-2-pyrrolidone solution which contains the liquid crystallinity polyester of a formula (2) and (3) by 50:50 (weight ratio) was prepared.

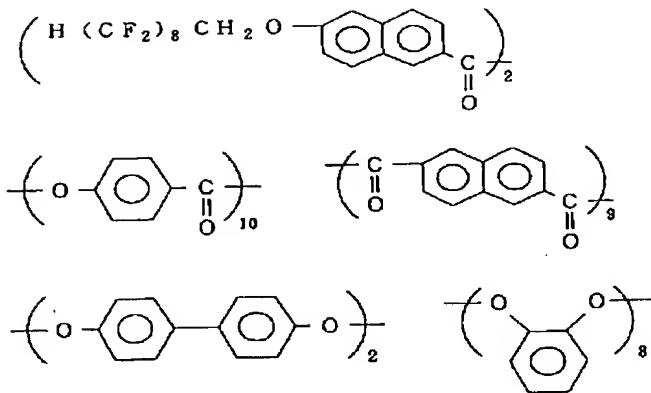
[0252] After applying the solution concerned covering die length of 10m by the die coat method on the polyether ether ketone film with a width of face of 40cm which carried out rubbing processing and drying by 120-degree C hot blast, heat treatment was performed for 10 minutes at 220 degrees C. Then, it cooled and the orientation of the polyester constituent (constituent which contains the polyester of a formula (9) and (10) by 50:50 (weight ratio)) concerned was fixed.

[0253] The binder was minded [of the obtained film 5], lamination and the polyether ether ketone film subsequently used as an orientation substrate were exfoliated, triacetyl cellulose was removed, and the film 5 was imprinted on the triacetyl cellulose film. The average tilt angle of 0.60 micrometers and the direction of thickness of the thickness of a film 5 was 35 degrees. Using the film 5 imprinted on this triacetyl cellulose film two sheets, every one sheet of the film concerned has been arranged to the upper and lower sides of TN cel so that it may become the arrangement shown in drawing 8. The same thing as the cel concerned used in the example 1 was used for used TN cel. The result of having measured the contrast ratio in an omnidirection by the same approach as an example 1 was shown in drawing 10.

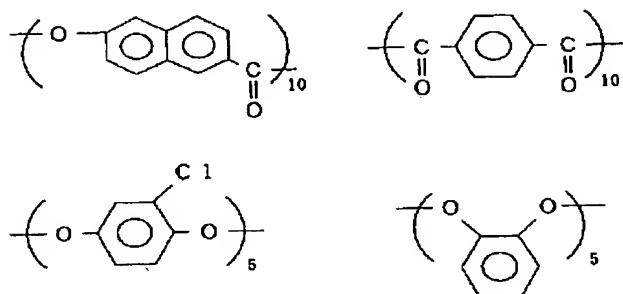
[0254]

[Formula 84]

式 (2)



式 (3)



[0255] except for not using example of comparison 1 film 4 -- all -- an example 1 -- the same -- carrying out -- etc. -- the contrast curve was drawn. The result is shown in drawing 11.

[Brief Description of the Drawings]

[Drawing 1] The conceptual diagram of the direction of a tilt in this invention.

[Drawing 2] The conceptual diagram of the direction of a pre tilt in this invention.

[Drawing 3] The plot plan of an optical measurement system used for tilt angle measurement of a compensation film.

[Drawing 4] Relation between the sample in the optical measurement system used for tilt angle measurement of a compensation film, and axial bearing of a polarizing plate.

[Drawing 5] Relation of the apparent retardation value and the angle of inclination of a sample in the example of reference.

[Drawing 6] Relation with the retardation value of the appearance in the thickness and the transverse plane after immersion of the compensation film in the example of reference.

[Drawing 7] The conceptual diagram of the oriented structure of a compensation film.

[Drawing 8] Axial arrangement of each optical element in examples 1 and 2.

[Drawing 9] Contrast curves, such as an example 1.

[Drawing 10] Contrast curves, such as an example 2.

[Drawing 11] Contrast curve, such as the example 1 of a comparison.